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THE MISIDENTIFICATION OF *ERAX* SCOPOLI IN THE AMERICAS (Diptera: Asilidae)

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Oregon State College

For many years the name *Erax* Scopoli has been used for one of the largest genera of Asilidae in the Western Hemisphere. The following review of the status of this name shows that it is not available for North and South American species.

The Palearctic genus *Erax* Scopoli (1763) has been erected for nearly two centuries. According to Hine (1919), the 14 species that Scopoli originally placed in *Erax* were reassigned by authors to other genera, resulting in the genus being without any species. After being stripped of species, the genus was not correctly identified again until the beginning of the present century. Kertesz (1909) first calls attention to the identity of *Erax* Scopoli that had been long unused for Palearctic species. He considered the Palearctic *Protophanes punctatus* (Meigen) (1804), the genotype of *Protophanes* Loew (1860), as a doubtful synonym of the Palearctic *Erax barbatus* Scopoli. A year later Coquillett (1910) considered *Protophanes* Loew as a synonym of *Erax* Scopoli. At the same time he designated *Erax barbatus* Scopoli, one of the original species of the genus [not the Nearctic *Erax barbatus* (Fabricius)], as the genotype. Also, Engel (1926) in his monograph on Palearctic Asilidae considered *Protophanes punctatus* as a doubtful synonym.

In 1936 Hobby concludes positively that the Palearctic *Protophanes* Loew is a synonym of the Palearctic *Erax* Scopoli. In his paper Hobby states: "*Asilus punctatus* Meigen (1804) is identical with *Asilus punctipennis* Meigen (1820) which is one of the three species placed in the genus *Protophanes* by Loew . . . ." ". . . Kertesz . . . was certainly correct in assigning them to the same genus. *Protophanes* Loew is, therefore, a synonym of *Erax* Scopoli."

Hobby concludes his discussion of *Erax* with this statement: "The application of the name *Erax* to the species of the Palearctic *Protophanes* would however, be unfortunate and is, I believe sufficient reason to ask the International Commission to frame an Opinion adding *Protophanes* to the Official List of Generic Names." The present writer has found no record of the name *Protophanes* being declared either valid or invalid by the International Commission.

In spite of the re-establishment of the identity of the genus *Erax* as early as 1909, the assigning of Western Hemisphere species to *Erax* has continued. The use of *Erax* Scopoli for western species began in 1838. At this time Macquart, by misidentification, brought the species-stripped *Erax* into active use by assigning to it 27 new species and two of Wiedemann's species. These were mainly from North and South America. At that time Macquart should have erected a new genus, or new genera, rather than

assigning his species to the Paleartic *Erax* Scopoli. The species of the two genera are definitely not congeneric. *Erax* Scopoli is more closely related to the *Asilus* complex of genera, while *Erax* sensu Macquart with several closely related genera form a distinct supergenus. The genotypes of the closely related genera are usually some of Macquart's species.

Since the publishing of Macquart's 1838 paper, about 160 of approximately 170 species of *Erax* sensu Macquart have been described from North and South America. Hine (1919) lists 74 species from North America and the Caribbean area and 17 more species have been added since that time. Williston (1891) lists 72 species and Kertesz (1909) 60 species from South America. In addition, five species have been reported from Australia, two from China, and one each from Africa, India, Nepal, the Philippine Islands and Formosa. Apparently only one or two species have been assigned to *Erax* from these areas since Macquart's time. For this reason the relation of *Erax* species from other parts of the world to North and South American species of *Erax* sensu Macquart is to be questioned. No *Erax* sensu Macquart have been reported from Europe or Asia Minor, the region where the true *Erax* Scopoli is found.

Several writers, who were strongly in favor of the usage of *Erax* sensu Macquart for Western Hemisphere species, have associated Macquart's name with *Erax* rather than Scopoli's in generic citations. Osten Sacken (1858) cites Scopoli but later he (1887) and Williston (1883; 1891; 1901) use the citation "*Erax* Macquart" in treating Western Hemisphere species. Also, van der Wulp (1898) for Macquart's species of *Erax* from southeastern Asia, and Bromley (1945) for two species of *Erax* from China, and again (1937; 1951) for Western Hemisphere species, cite "*Erax* Macquart." Hine (1919) in his revision of the genus for North America refrained from using an author's name although he goes on the record as being in favor of "*Erax* Macquart." Hine writes: "It is evident therefore, that opportunity for a change of generic name is present, but no action is taken because I am satisfied to use *Erax* in Macquart's sense and thus obviate the change which another interpretation would involve." Also, as though to further establish Macquart as author of *Erax,* Hine sets up the North American *Erax rufibarbis* Macquart as the genotype of *Erax*! Nine years previously Coquillett (1910) had designated the European *Erax barbatus* Scopoli as the genotype. Bromley *(loc. cit.)* in his writings also made an effort to support Hine by citing *Erax rufibarbis* as the genotype, ignoring the prior designation of Coquillett.

Coquillett (1910) and Hobby (1936) have attempted to clarify the status of the Nearctic and Neotropical species misidentified as *Erax* by assigning them to valid Neotropical genera. Coquillett attempted to substitute *Eicherax* for *Erax* by considering *Erax auctorum* as equalling *Eicherax* Bigot (1857). Bigot erected this genus by designating *Erax simplex* Macquart (1838) as the genotype by monotypy.

Carrera (1950; 1959) considers *Eicherax* as a valid genus; Curran (1934) and Bromley (1934) included species of *Eicherax* in *Erax*. Later, Bromley (1937; 1946) admitted the distinctiveness of *Eicherax* by listing four species in the genus from Brazil which include the widespread *E.*

nigripes (Bellardi) and *E. macularis* (Wiedemann). James (1953) considers *Eicherax* as a valid genus and adds a fifth species, *E. flavescens* from Honduras.

Eicherax nigripes is one of the two species that had been assigned by Bellardi (1861) to the genus *Erax,* subgenus *Eristicus.* Prior to this designation, Loew had erected the genus *Eristicus* in 1848 without assigning any species to it. The type of *Eristicus* would have to be the Mexican species *nigripes* Bellardi by monotypy, the only name that is available. The second species, *Erax (Eristicus) villosus* Bellardi was considered a synonym of *Erax maculatus* Macquart by Osten Sacken (1887). The latter has since proved to be a synonym of *Erax interruptus* Macquart which was erroneously designated by Coquillett (1910) as the type of *Eristicus.*

Osten Sacken (1878) believed that he had established the identity of *Eristicus* Loew when he found a specimen in the Museum of Comparative Zoology labeled by Loew as *Erax ambiguus* Macquart. Later this specimen proved not to have the characters of *Eristicus;* it is now known to be *Erax interruptus* Macquart.

Osten Sacken (1878) proposed *Neoeristicus* for *Eristicus* Loew because the name was preoccupied by *Eristicus* Wesmel (1844) in Hymenoptera. Kertesz (1909) assigns *Eristicus nigripes* Bellardi to *Neoeristicus* O. S. In 1910, Coquillett correctly designated *Neoeristicus* O. S. as a synonym of *Eicherax* Bigot. Hine (1917) also assigned *Eristicus nigripes* Bellardi to *Eicherax.*

Hobby (1936) erroneously believes that the name *Erax:* ". . . may well be referred to *Eichoichemus* Bigot, with the genotype *Erax flavianalis* Macquart (1848) by monotypy"; this species is from Brazil. In addition to *flavianalis,* Kertesz (1909) assigned five other species to *Eichoichemus.* These five belong to the Nearctic *Erax* auctorum and not to *Eichoichemus.* Bromley (1937) considered *Eichoichemus* a valid South American genus, listing eight species in it that were originally assigned to *Erax, Asilus* and *Promachus.* Carrera (1950; 1959) accords generic status to *Eichoichemus.*

Hobby involved the name *Telejoneura* Rondani (1863) with the *Erax* problem. However, this name was proposed as a new name for *Trupanea* Macquart (1938) (now *Promachus* Loew) a homonym. Hobby was in error in considering *Erax completus* Macquart as the genotype, his decision being based on a concept and not on a name.

The first generic name available for the North and South American genus of *Erax* auctorum is *Efferia* Coquillett (1893). Coquillett (1910) erroneously considered *Efferia* as a synonym of the Neotropical *Eichoichemus* Bigot. At the same time he designated *Efferia candida* Coquillett (1893) as the genotype of *Efferia* Coquillett. Therefore, because of misidentification, those species assigned to *Erax* sensu Macquart will have to be reassigned to the genus *Efferia.* Hine (1919) has divided the genus into groups; one or more of these groups may later prove to represent subgenera. Such a change involves approximately 175 species, many of them having been erroneously assigned to *Erax* for over 100 years.

The writer is indebted to Dr. A. Earl Pritchard (University of California at Berkeley) for his suggestions concerning the problems discussed here.

LITERATURE CITED

Aldrich, J. M. 1905. A catalog of North American Diptera. Smithsonian Misc. Coll. 46:275.

Bellardi, L. 1861. Saggio di ditterologia messicana. Part 2. Torino: 48; 49.

Bigot, J. M. F. 1857. D'un classification générale et synoptique de l'ordre les Insectes Diptéres. Asilidi. Ent. Soc. France Ann., series 3, 5:532.

Bromley, S. W. 1934. Asilidae *in* C. H. Curran, The Diptera of Kartabo, Bartica District, British Guiana. Bull. Amer. Mus. Nat. Hist. 66(3):327-360.

———. 1937. New and little known Utah Diptera with notes on the taxonomy of Diptera. Utah Acad. Science, Arts and Letters. 14:102-103.

———. 1945. The robber flies and bee-killers of China (Diptera: Asilidae). Lingnan Science Journal 21:101.

———. 1946. The robber flies of Brazil. Livro de homenagem a R. R. d'Almeida, no. 8:103-120.

———. 1951. Asilid notes (Diptera) with descriptions of thirty-two new species. Amer. Mus. Novitates 1532:26.

Carrera, Messias. 1950. Synoptical keys for the genera of Brazilian Asilidae (Diptera). Rev. Brasil Biol. 10(1):99-111.

———. 1959. Sôbre alguns Asilideos neotropicais (Diptera) do "Zoologische Sammulung des Bayerischen Staats." Opuscula Zoologica. 30:1-13.

Curran, C. H. 1930. New American Asilidae (Diptera). Amer. Mus. Novitates 425:1-21.

———. 1934. The families and genera of North American Diptera. 512 pp. New York.

Coquillett, D. W. 1893. A new asilid genus related to *Erax*. Canadian Entomologist. 35:175-177.

———. 1910. The type-species of the North American genera of Diptera. U. S. Natl. Mus. Proc. 37:499-647.

Engel, E. D. 1926. Asilidae, *in* Lintner, Die Fliegen der palaarktischen Region. 24:90. Stuttgart.

Hine, J. S. 1917. Costa Rican Diptera collected by Philip P. Calvert, Ph.D., 1909-1910. Paper 2. Tabanidae and Asilidae. Ent. Soc. Amer. Trans. 12:298-299.

———. 1919. Robberflies of the genus *Erax*. Ent. Soc. Amer. Ann. 12:103-154.

Hobby, B. M. 1936. The Ethiopian species of the Fasciata Group of the genus *Bactria* (=*Promachus*) (Diptera, Asilidae). Ent. Monthly Magazine. 72:182-183; 276-277.

Kertesz, C. 1909. Catalogus Dipterorum. 4:273. Budapest.

Loew, H. 1848. Ueber de europaischen Raubfliegen (Diptera asilica). Linnaea Entomol., 3:96 *(Eristicus)*.

———. 1860. Dipt.-Fauna Sudafrika's. 1:143.

Macquart, J. 1838. Diptéres exotiques noveaux ou peu connus. Paris. 1(2):105-119.

Meigen, J. W. 1804. Klassiffikazion und beschreibung der europaischen zweiflugeligen insekten (Diptera Linn.) Braunscherg. 1:248.

Osten Sacken, C. R. 1858. Catalogue of the described Diptera of North America. (ed. 1). Smithsn. Misc. Coll. 3(1):33.

———. 1878. *Ibid.* (ed. 2). 16(270):79; 81.

———. 1887. Diptera, *in* Godman, E. D. and O. Salvin, Biologia Centrali-Americana. Insecta. 1:197.

Rondani, C. 1863. Archivo Zool. Fisiol., 3, fasc. 1, p. 48.

Scopoli, J. A. 1763. Entomologia carniolica etc. Vindobonae: p. 359.

Williston, S. W. 1885. On North American Asilidae (Part II). Amer. Ent. Soc. Trans. 12:64.

———. 1891. Catalogue of the described species of South American Asilidae. Amer. Ent. Soc. Trans. 13:84.

———. 1901. Diptera, *in* Godman, E. D. and O. Salvin, Biologia Centrali-Americana. Insecta. 1:322.

van der Wulp, F. M. 1896. Catalogue of the described Diptera from South Asia. The Hague. p. 94.

STUDIES OF RELATIVE GROWTH IN GERRIDAE(4) (Hemiptera: Heteroptera)[1]

RYUICHI MATSUDA

This is the fourth of a series of works in which it is proposed to study the postembryonic development of the antennal and leg segments in relation to the total body length in Gerridae. The main problems concerned have been presented in the form of hypotheses in the first paper of this series of works (Matsuda, in press) so that they are not repeated here but are referred to whenever necessary in discussion. Two species of the genus *Platygerris, P. caeruleus* Champion and *P. asymmetricus* Hungerford, are treated. Three adult males of *P. depressus* Champion are measured for their body lengths and segmental lengths to study the species-form allomorphosis in this genus.

RECOGNITION OF NYMPHS

The nymphs and adults of *P. asymmetricus* were collected from the Tiribi river, San José, Costa Rica. Only this species of *Platygerris* was found during intensive collecting for over two months on this river. The nymphs and adults of *P. caeruleus* were collected from a river at Alajuela, Costa Rica. On this river both *P. caeruleus* and *P. asymmetricus* were found to occur simultaneously, but the absence of the paired oblique stripes on the mesosternum (Pl. 1, K) in *P. caeruleus* makes possible the segregation of the nymphs of *P. caeruleus* from those of *P. asymmetricus*. Apparently the stripes do not occur in the first stage nymphs of either species, so that distinction between the first stage nymphs of the two species is extremely difficult. The first stage nymph of P. *caeruleus* is, therefore, excluded from the study.

In the first stage nymph of *P. asymmetricus* (Pl. 1, H), the upper-surface of the body is predominantly pale brown, with paired dark spots on the pro-, meso-, and metanota, and on the abdominal terga. The cleavage line on the head is distinct. The mesothorax is pale ventrally and without paired oblique dark spots.

In the second and third stages (F, G, I, J, K), the paired dark stripes appear on the mesosternum and become increasingly darker in *P. asymmetricus,* while the stripes are absent in *P. caeruleus*. The mesonotal spots become approximated to each other on the median longitudinal axis in both species.

In the fourth stage (E, L), the sexual differentiation becomes recognizable on the ventral side of the eighth abdominal segment in both species. The eighth segment in the female is shorter than in the male, and with a dark median longitudinal line on the ventral side where a split occurs in later stages. The eighth and ninth abdominal segments are each provided

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with a brown spot on the ventral surface in *P. asymmetricus,* while the ventral surfaces of the same segments are simply whitish in *P. caeruleus.* The mesonotum is reddish brown laterally in both species. The mesonotal black spots become continuous basally, and the spots are developed more extensively forward in *P. asymmetricus* than in *P. caeruleus.* The oblique stripes on the mesosternum are very well marked in *P. asymmetricus,* while they are absent in *P. caeruleus.*

In the fifth stage (C, D, M, N), the darker areas on the body surface are larger in both species. The eighth abdominal segment in the male is not much longer in *P. caeruleus* than in *P. asymmetricus.* It is at the final stage of development into the adult that the characteristically enormous prolongation of the eighth abdominal segment in the male of *P. caeruleus* occurs (A). It can be said, based on the above description, that the specific differentiation in structures becomes progressively more distinct with developmental progress, as in the other genera of Gerridae thus far studied.

In this genus also, as in *Potamobates,* conspicuous lobate claws occur on the nymphal middle and hind legs. Since the shape as well as the position of claws at each developmental stage is practically the same, the following description applies to both species.

In the first stage the claws are large and largely colorless, arising from a little beyond the middle of the middle tarsus and from near the apical third of the hind tarsus (Fig. 1, a, b). They become progressively reduced in size and arise more apically with developmental progress. In the third stage, the middle tarsus becomes two-segmented and the claws arise from a little beyond the middle of the second segment; the claws arise from near the apical fourth of the unsegmented tarsus in the hind leg. In the fourth stage (Fig. 1, e, f), the claws arise from the apical third of the second tarsal segment in both legs (tarsal segmentation in the hind leg occurs in this stage). In the fifth stage the claws arise from near the apical fourth of the second tarsal segment in both middle and hind legs. The claws are lost in the adult stage.

COMPARISON OF GROWTH PATTERNS

As noted in Table 3, the growth ratios of all segments in *P. asymmetricus* are greater than those of the corresponding segments in *P. caeruleus,* and the initial growth indices for all segments in the former species are smaller than those for the corresponding segments in the latter species. *Hypothesis 1, that when the growth ratio or the initial growth index for a segment varies among a group of related species, the ratio or the index for other segments varies in a parallel fashion, holds true.*

No tendency is noted for the segments with higher growth ratios to be

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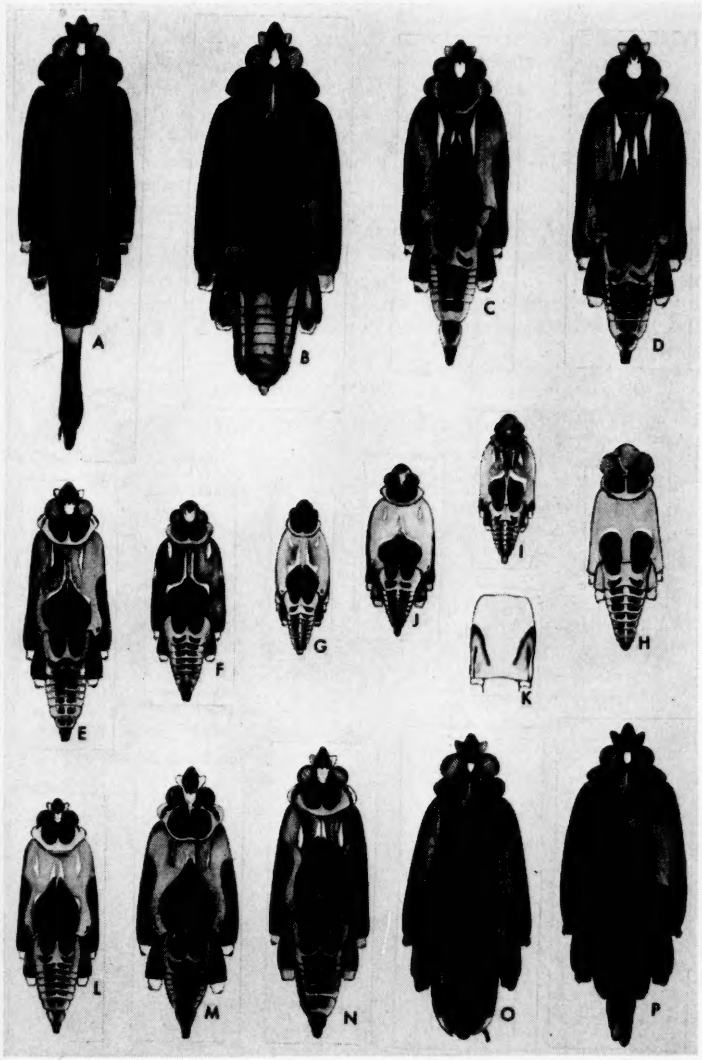
PLATE I. A to G, *Platygerris caeruleus* Champion: A, adult male; B, adult female; C, male fifth stage nymph; D, female fifth stage nymph; E, male fourth stage nymph; F, third stage nymph; G, second stage nymph. H to P, *Platygerris asymmetricus* Hungerford: H, first stage nymph (magnification 2.12 times that of others); I, second stage nymph; J, third stage nymph; K, mesosternum of third stage nymph; L, male fourth stage nymph; M, male fifth stage nymph; N, female fifth stage nymph; O, adult female; P, adult male.


A
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C
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similar in growth pattern (hypothesis 2) in P. asymmetricus and P. caeruleus. The growth patterns of the hind tarsus are most similar between the two species, although the growth ratios for the segment are relatively low in both species.

The inverse relation between the two parameters, b (initial growth index) and k (growth ratio) (hypothesis 2) generally holds. At the interspecific level, k in *P. asymmetricus* is greater than that in *P. caeruleus* in all segments, and b in the former species is smaller than that in *P. caeruleus* in all segments. This is the case in which hypotheses 1 and 3 apply together to all segments, each reflecting the presence of the other. Among the segments of the front leg in the same species, however, the hypothesis does not hold. In *P. caeruleus* the growth ratio for the tarsus is smaller than the ratios for the femur and tibia, and the initial growth index for the tarsus is also smaller than for the latter segments. In *P. asymmetricus* the growth ratio for the tarsus is smaller than that for the tibia, but the difference in the initial growth index between the two segments is not statistically significant.

TAXONOMIC SIGNIFICANCE AND THE SPECIES-FORM ALLOMORPHOSIS

As noted in figures 2 to 5, the points representing the segments in *P.*

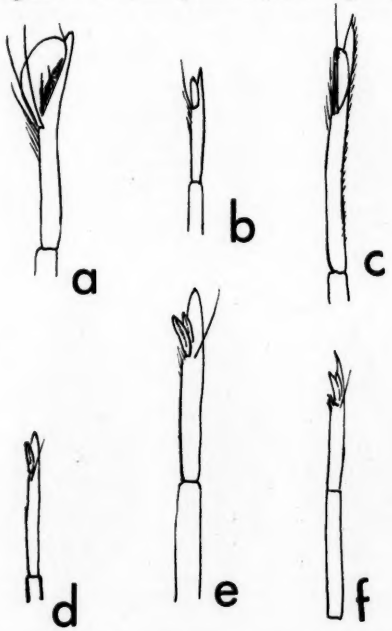

FIG. 1. *Platygerris asymmetricus* Hungerford: a, c, e, middle claws at first, second, and fourth stages; b, d, f, hind claws in same stages.

depressus fall in the areas closer to the growth lines for segments in *P. asymmetricus* than to those in *P. caeruleus*. This is especially clearly seen

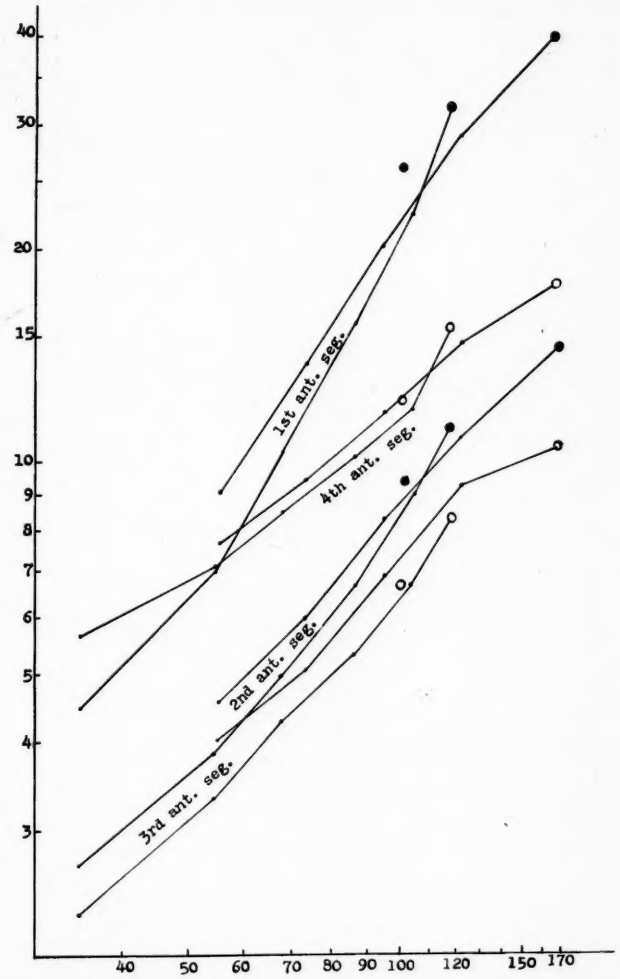

FIG. 2. Antenna. Small points represent the mean values at different developmental stages. Points not connected by lines are *P. depressus*. *P. asymmetricus* is plotted from the first stage, *caeruleus* from the second. Body length shown on abscissa, segments on ordinate.

when the growth lines do not cross each other near the points for *P. depressus* (*e.g.*, third antennal segment, front tarsus, middle femur, middle tarsus, hind femur, hind tarsus) suggesting that the growth patterns of segments in *P. depressus* are more similar to those in *P. asymmetricus* than

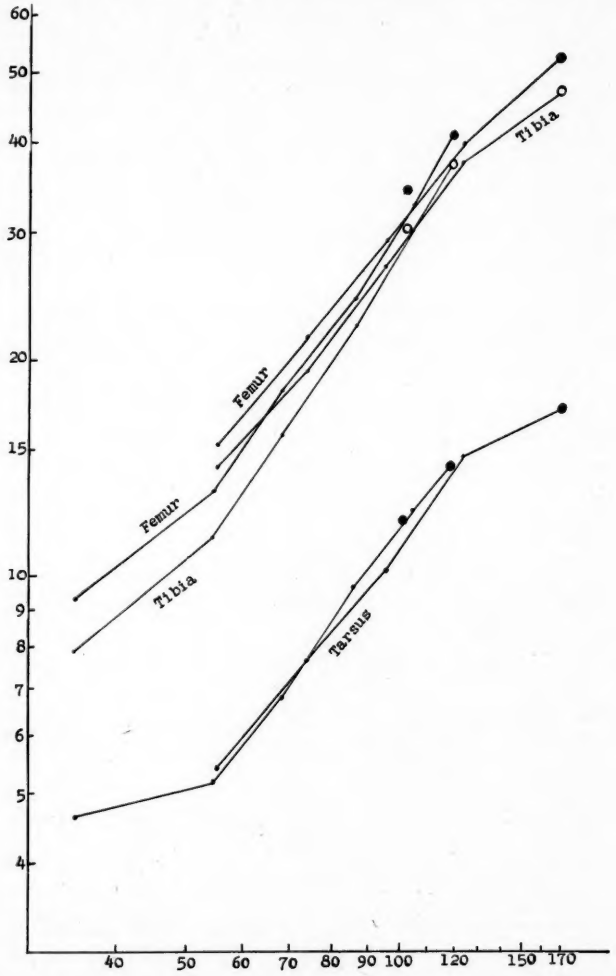

FIG. 3. Front leg. Small points represent mean values at different developmental stages. Points not connected by lines are *P. depressus*. *P. asymmetricus* is plotted from the first stage. For fuller explanation see Fig. 2.

to those in *P. caeruleus* (*P. asymmetricus* and *P. depressus* are closely related).

Assuming that the growth patterns in *P. asymmetricus* and *P. depressus* are similar, the growth patterns in *P. caeruleus* are greatly different from

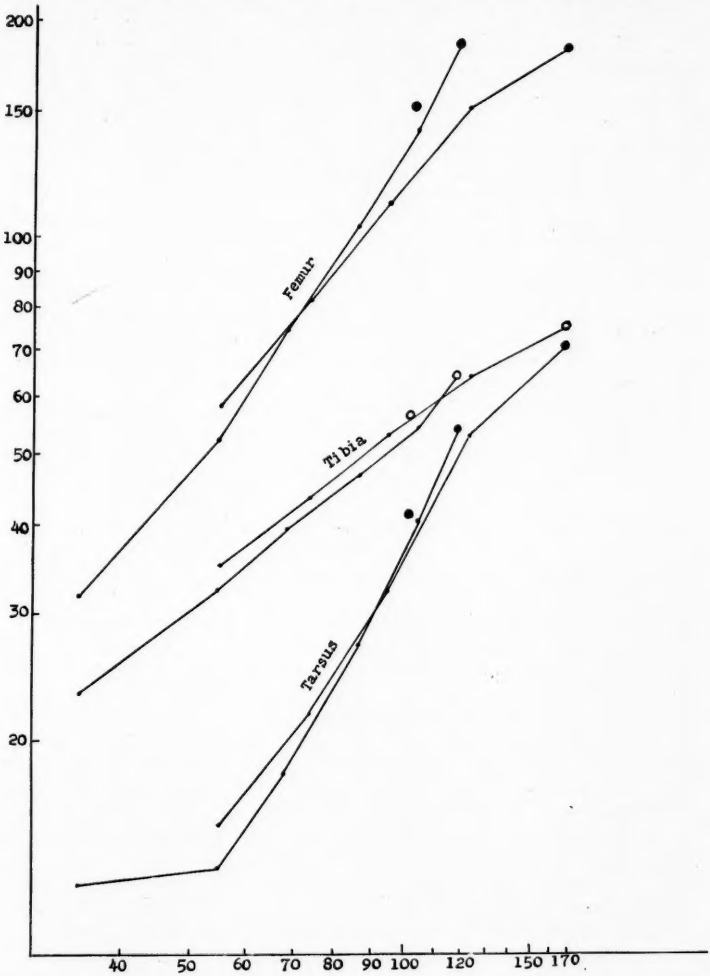

FIG. 4. Middle leg. Small points represent mean values at different developmental stages. Points not connected by lines are *P. depressus*. *P. asymmetricus* is plotted from the first stage. For fuller explanation see Fig. 2.

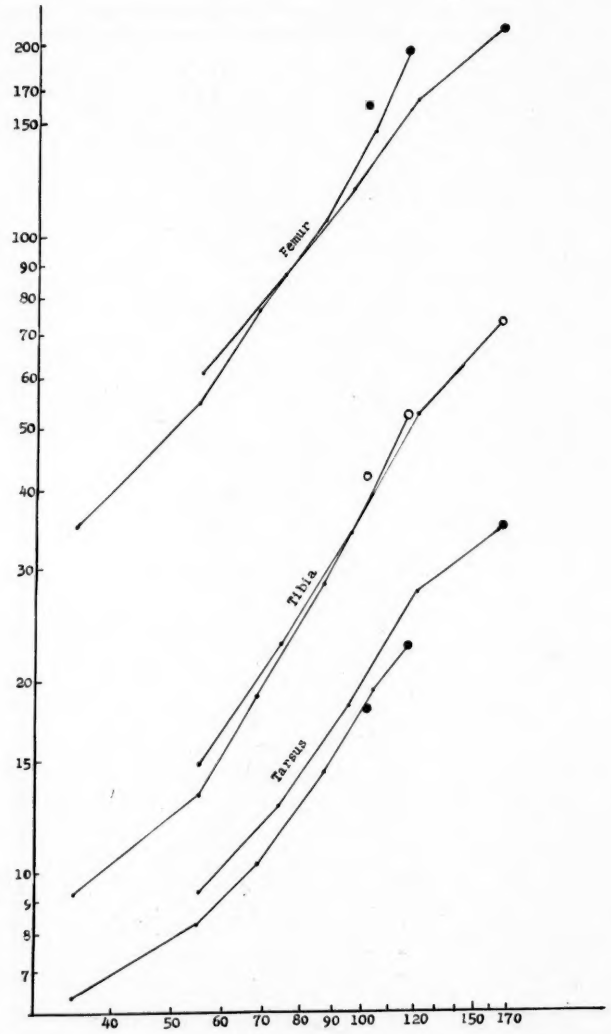

FIG. 5. Hind leg. Small points represent mean values at different developmental stages. Points not connected by lines are *P. depressus*. *P. asymmetricus* is plotted from the first stage. For fuller explanation see Fig. 2.

those in the other two species. In fact, the magnitude of differences in growth pattern in terms of the growth ratio and the initial growth index is about as great as that between two species representing two different subgenera of *Gerris* (Matsuda, 1960). Combined with an enormous prolongation of the eighth abdominal segment in the male of *P. caeruleus,* the difference in growth pattern between the two groups of species may justify the division of the genus *Platygerris* into two subgenera.

As in *Potamobates,* the growth center of the front leg is located in the tibia in *P. asymmetricus,* and in the tibia or the femur in *P. caeruleus* (the difference in the calculated growth ratio between the two segments is not statistically significant). As in *Potamobates,* the growth center is in the tarsus in the middle leg, and in the tibia in the hind leg in both species. The growth ratios of the last two segments are also remarkably high as in *Potamobates.* Inversely related with these high growth ratios, the initial growth indices for these segments are relatively low, although greater than in *Potamobates.** Another similarity in growth pattern between *Potamobates* and *Platygerris* is that the middle tarsus grows very slightly in the first developmental stage. The genus *Platygerris* was formerly assigned to Halobatinae, while its close relative, *Potamobates,* belonged to Gerrinae. The similarity in growth patterns of segments, as well as the similarity in the basic structural plan of the two genera, including the occurrence of the conspicuous nymphal claws that have been found in this series of works, apparently justifies a new classification of the Gerridae in which both genera, together with *Cylindrostethus,* constitute a distinct tribe within the subfamily Gerrinae (Matsuda, 1960). The study of the growth pattern in *Cylindrostethus* remains to be made.

The difference in growth pattern between *Platygerris* and *Potamobates* lies at least in the initial growth index for the hind tibia. The values of b for the hind tibia are much higher than those in two species of *Potamobates.**

The species of *Platygerris* inhabit swift currents. One of the most important requisites for maintaining their bodies on the rapidly running water must be the development of relatively long basal leg segments, and a special growth pattern must have been acquired in adaptation to the peculiar environment. This is apparently the case in this genus. In *P. caeruleus* the initial growth indices for the middle and hind femora are much greater than those for the same segments in species of *Gerris, Eurygerris,* and *Limnogonus,* although the growth ratios for the segments are about as great as in *Limnogonus* or *Eurygerris.* In *P. asymmetricus* the growth ratios for the middle and hind femora are remarkably high, although the initial growth indices for the same segments are even a little smaller than in *Eurygerris,* but the rapid growth of the segments will help in completing their life cycle on swift currents. In fact, *P. asymmetricus* and *P. depressus* are the only species of Gerridae in which the middle and hind femora are over one and a half times as long as the body.

* —1.5564 in *P. caeruleus* (tibia, 2nd stage nymph to adult male) and —1.2677 in *P. asymmetricus* (tibia, first stage nymph to adult male), while they are —3.0931 and —3.0287 respectively in the two species of *Potamobates* studied.

TABLE 1. Measurements of the body length, antennal and leg segments, *Platygerris asymmetricus* Hungerford.
The values in parentheses are mean values of ten individuals at each stage.

	1st	2nd	3rd	4th ♂	5th ♂	Adult ♂
Length of body	31.0-38.5 (34.90)	47.0-57.0 (54.30)	61.5-73.0 (67.85)	80.0-90.5 (86.15)	98.0-106.0 (103.70)	115.0-120.0 (117.10)
1st ant. seg.	4.3-4.7 (4.44)	6.8-7.2 (6.97)	10.0-10.5 (10.30)	15.0-16.0 (15.70)	22.0-23.0 (22.50)	31.0-34.0 (32.0)
2nd ant. seg.	2.5-3.0 (2.67)	3.5-4.0 (3.84)	4.8-5.0 (4.96)	6.5-7.0 (6.65)	8.5-9.5 (9.10)	10.5-12.0 (11.27)
3rd ant. seg.	2.2-2.5 (2.27)	3.2-3.4 (3.31)	4.1-4.6 (4.30)	5.0-5.5 (5.21)	6.3-7.0 (6.73)	7.5-9.0 (8.25)
4th ant. seg.	5.3-6.0 (5.65)	7.0-7.2 (7.03)	8.3-8.7 (8.54)	10.0-11.0 (10.32)	12.0-14.0 (12.95)	15.0-16.0 (15.50)
Front femur	9.0-9.6 (9.34)	12.5-13.5 (13.19)	17.0-19.0 (18.05)	23.0-25.0 (24.10)	32.0-33.0 (32.20)	38.5-41.0 (40.15)
Front tibia	7.5-8.1 (7.88)	11.0-11.8 (11.40)	15.3-17.0 (15.79)	21.0-23.0 (22.10)	29.0-31.0 (30.10)	36.0-40.0 (37.80)
Front tarsus	4.5-4.8 (4.66)	5.0-5.3 (5.14)	6.5-7.0 (6.80)	9.5-10.0 (9.71)	11.5-13.0 (12.15)	13.5-15.0 (14.05)
Middle femur	31.0-33.0 (31.90)	51.5-54.0 (52.45)	72.0-78.0 (74.00)	99.5-110.0 (103.50)	138.0-150.0 (141.30)	177.0-193.0 (186.60)
Middle tibia	23.0-24.0 (23.40)	31.5-33.0 (32.20)	37.0-40.0 (39.05)	45.0-48.5 (46.60)	52.0-58.0 (54.70)	61.5-67.5 (64.35)
Middle tarsus	12.0-13.0 (12.63)	13.0-13.5 (13.30)	17.0-18.5 (17.95)	24.5-29.0 (27.23)	38.0-44.0 (40.15)	51.0-59.5 (54.25)
Hind femur	34.0-36.0 (34.95)	52.0-58.5 (54.80)	74.0-81.0 (76.35)	100.0-113.0 (106.40)	140.0-150.0 (145.60)	190.0-208.0 (197.50)
Hind tibia	8.5-9.5 (9.28)	13.0-14.0 (13.30)	19.0-20.0 (19.25)	27.0-29.5 (28.75)	37.0-42.0 (39.60)	49.5-55.0 (52.45)
Hind tarsus	6.0-6.5 (6.37)	8.0-9.0 (8.25)	10.0-10.5 (10.35)	13.5-15.0 (14.35)	18.0-20.5 (19.55)	20.5-25.6 (22.25)

Platygerris caeruleus Champion.

(6.37)	(8.25)	(10.35)	(14.35)	(19.55)	20.5-25.6 (22.25)

TABLE 2. Measurements of the body length, antennal and leg segments, *Platygerris caeruleus* Champion.
The values in parentheses are mean values of ten individuals at each stage.

	1st	2nd	3rd	4th ♂	5th ♂	Adult ♂
Length of body		50.0-61.0 (55.0)	65.0-82.0 (73.70)	92.0-104.0 (95.60)	113.0-125.0 (122.00)	160.0-175.0 (167.30)
1st ant. seg.		8.6-9.0 (8.95)	12.0-14.0 (13.32)	19.5-21.0 (20.10)	28.5-30.5 (29.70)	38.5-42.0 (39.95)
2nd ant. seg.		4.5-4.7 (4.58)	5.7-6.4 (6.01)	8.1-9.0 (8.42)	10.5-11.0 (10.77)	13.8-15.5 (14.46)
3rd ant. seg.		3.9-4.3 (4.05)	4.8-5.4 (5.07)	6.5-7.3 (6.98)	8.8-9.5 (9.30)	10.0-11.0 (10.51)
4th ant. seg.		7.3-8.1 (7.71)	9.0-10.0 (9.43)	11.5-12.4 (11.84)	14.5-15.0 (14.85)	17.0-19.0 (18.02)
Front femur		14.5-16.0 (15.20)	20.0-22.5 (21.55)	28.0-30.0 (28.95)	39.0-40.0 (39.70)	50.0-53.0 (52.01)
Front tibia		13.8-14.5 (14.15)	18.0-20.0 (19.23)	26.5-28.0 (26.81)	36.0-39.0 (37.20)	45.0-49.0 (46.65)
Front tarsus		5.1-6.0 (5.42)	7.2-8.5 (7.64)	10.0-10.5 (10.16)	14.0-15.0 (14.85)	15.5-18.7 (16.97)
Middle femur		56.5-60.0 (58.45)	78.0-85.0 (82.35)	107.0-114.0 (111.50)	146.0-155.0 (150.10)	170.0-187.0 (182.20)
Middle tibia		33.0-37.0 (35.10)	42.0-45.0 (43.70)	52.0-55.0 (53.00)	60.0-67.0 (64.40)	70.0-80.0 (74.75)
Middle tarsus		14.5-16.0 (15.20)	20.5-23.5 (21.77)	31.0-33.0 (32.45)	49.0-55.0 (53.10)	67.0-73.0 (70.65)
Hind femur		60.0-63.0 (61.30)	85.0-90.0 (86.95)	114.0-123.0 (118.0)	158.0-169.0 (163.30)	203.0-221.0 (210.40)
Hind tibia		14.0-15.0 (14.95)	21.5-24.5 (22.95)	33.0-35.0 (34.35)	50.0-55.0 (53.05)	70.5-79.0 (73.85)
Hind tarsus		9.0-9.5 (9.38)	12.0-14.0 (12.76)	18.0-19.0 (18.56)	26.0-30.0 (28.00)	32.0-37.0 (35.05)

Due to the smaller growth ratios and greater initial growth indices for segments in the longest species, *P. caeruleus*, the allomorphic slopes are more nearly horizontal than the growth slopes in most segments, as noted in figures 2 to 5. The allomorphic slope for the hind tarsus is nearly in conformity with the growth lines for this segment, since the growth patterns for this segment are similar in the two species (probably in all three species).

TABLE 3. Comparison of growth pattern.
Growth ratio(k) in male.

	Growth ratio(k)		
	P. caeruleus	*P. asymmetricus*	Significance levels
1st ant. seg.	1.3486	1.8437(1.5904)	P<0.01
2nd ant. seg.	1.0229	1.3282(1.1367)	P<0.01
3rd ant. seg.	0.8877	1.0865(1.0288)	P<0.01
4th ant. seg.	0.7719	0.9261(0.8102)	P<0.01
Front femur	1.0944	1.3742(1.1877)	P<0.01
Front tibia	1.0816	1.4708(1.2818)	P<0.01
Front tarsus	1.0065	1.2521(0.9484)	P<0.01
Middle femur	1.1361	1.5272(1.4054)	P<0.01
Middle tibia	0.6720	0.8257(0.7972)	P<0.01
Middle tarsus	1.4028	1.7442	P<0.01
Hind femur	1.1033	1.5355(1.3729)	P<0.01
Hind tibia	1.4300	1.6654(1.4171)	P<0.01
Hind tarsus	1.2146	1.2804(1.0545)	0.1>P>0.5
	Initial growth index(b)		
1st ant. seg.	—1.3808	—2.3573(—1.8545)	P<0.01
2nd ant. seg.	—1.1152	—1.7227(—1.3480)	P<0.01
3rd ant. seg.	—0.9304	—1.3604(—1.2477)	P<0.01
4th ant. seg.	—0.4576	—0.8325(—0.5263)	P<0.01
Front femur	—0.7152	—1.2614(—0.8966)	P<0.01
Front tibia	—0.7232	—1.4856(—1.1158)	P<0.01
Front tarsus	—0.9239	—1.4491(—0.8546)	P<0.01
Middle femur	—0.2183	—0.9221(—0.6840)	P<0.01
Middle tibia	0.3856	0.0810(—0.1666)	P<0.01
Middle tarsus	—1.2620	—1.9121	P<0.01
Hind femur	—0.1190	—0.9212(—0.6032)	P<0.01
Hind tibia	—1.5564	—1.7539(—1.2677)	0.1>P>0.5
Hind tarsus	—1.1403	—1.3077(—0.8656)	0.1>P>0.5

The values in parentheses are for the entire developmental stages.

SUMMARY

This study concerns primarily the hypotheses put forward in connection with the study of relative growth in Gerridae. Genus *Platygerris* is treated in this work.

Hypothesis 1: "When the growth ratio or the initial growth index for a segment varies among a group of related species, the ratio or index for other segments varies in a parallel fashion" holds true both for the growth ratio and the initial growth index in all legs and antennae. Hypothesis 3; "When the growth ratio increases the initial growth index decreases, and vice versa" also holds at the interspecific level in all legs and the antennae.

No tendency is noted for the segments with higher growth ratios to be similar in growth pattern (hypothesis 2). Taxonomic significance of the growth pattern in *Platygerris* is discussed.

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LITERATURE CITED

Matsuda, R. 1960. Morphology, Evolution, and Classification of the Gerridae, Univ. Kansas Sci. Bull. 41(2):25-632.
———. Studies of relative growth in Gerridae(1), Ann. Ent. Soc. Amer. (in press).

OCCURRENCE OF AN UNUSUAL SPECIES OF *TETRASTICHUS* (Hymenoptera: Eulophidae) IN NEBRASKA[1]

GEORGE R. MANGLITZ

Teitelbaum & Black (1954) reported a chalcoid wasp, *Tetrastichus* sp. near *venustus* Gahan, as a new record for the United States. They observed the larvae at the Brooklyn (N.Y.) Botanic Garden feeding within the stems of sweetclover, *Melilotus alba* Desr. and *M. officinalis* (L.) Lam., and reported this species to be the only phytophagous *Tetrastichus* known to occur in North America. The following notes on what is apparently the same species[3] were made in the vicinity of Lincoln, Nebraska.

In February 1959, this insect was discovered in the greenhouse in cages with adults of the sweetclover weevil (*Sitona cylindricollis* Fahr.). It was immediately established, however, that the wasps were not emerging from the weevils but from the plants upon which the weevils were feeding. The only external signs of plant infestation were the adult emergence holes, about 0.5 mm. in diameter, along the sweetclover stems. Dissection of the stems revealed short tunnels averaging about 3.6 mm. in length and containing one larva, pupa, or new adult. Frequently tunnels were numerous and several were, in effect, joined. All the pupae and adults taken from stems of *Melilotus* spp. during the course of these observations were *Tetrastichus* sp., whereas most of the larvae were Cecidomyiidae (Itonididae) probably belonging to the genus *Contarinia* or *Dasyneura*.[4]

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[2] U.S.D.A., Agr. Res. Serv., Entomology Research Division, in cooperation with the Department of Entomology, University of Nebraska.

[3] Specimens were determined as *Tetrastichus* sp. near *venustus* Gahan by B. D. Burkes, Ent. Res. Div., ARS, USDA, who also made the determinations for Teitelbaum & Black.

[4] Dipterous larvae were identified by R. H. Foote, Ent. Res. Div., ARS, USDA.

This association of the *Tetrastichus* sp. with the dipterous larvae may cast doubt on its phytophagous habit. The reason to suspect that the dipterous larvae may have been parasitized was that none of the more mature stages of the Diptera were found and the only exit holes were clearly associated with adults of *Tetrastichus* by their characteristic frass and pupal remains, whereas among the immature stages the Diptera out-numbered the Hymenoptera by ratios as high as 30 to 2. Unfortunately, this does not constitute positive proof of parasitism.

Using uninfested plants from a different greenhouse section, it was possible, beginning with adults, to rear the *Tetrastichus* sp. in sweetclover stems without association with the dipterous larvae. Adults were successfully reared in about half the trials where females were confined to tips of growing stems. No success was obtained when seven single females were confined to older portions of the stems. Only females were observed throughout the course of the observations. Teitelbaum & Black reported finding only parthenogenic females which preferred young tip growth for oviposition sites; however, they found no other insects in association with the *Tetrastichus*.

All the sweetclover in the greenhouse section where the insect was discovered had been produced in the greenhouse from seed with the exception of a few plants produced from cuttings made in a field near Lincoln. On March 10 an examination in this field of stems from the previous season's growth revealed mature *Tetrastichus* larvae to be moderately abundant. Larvae collected on this date and brought into the laboratory emerged as adults on March 27. Infrequent observations in the greenhouse were made during the summer months. The adults became abundant as warm weather approached. In early October an intensive search of the greenhouse revealed no signs of an active infestation. At the same time a search in the vicinity of the original field collection revealed only a few tunnels, either empty or containing dead specimens.

The *Tetrastichus* sp. showed no preference for either *Melilotus alba* or *M. officinalis,* infesting them equally. Other leguminous plants were available to the *Tetrastichus* both in the greenhouse and in the field, but only these species of *Melilotus* were found to be infested.

The infestation reported by Teitelbaum & Black also ended in a sudden, unexplained reduction of these insects. Thus there is an unanswered question—is the *Tetrastichus* truly phytophagous? It may be able to subsist only for a few generations on plants in the absence of a preferred insect host, possibly a borer in the stems of *Melilotus*.

LITERATURE CITED

Teitelbaum, Shirley S., and L. M. Black. 1954. The effect of a phytophagous species of *Tetrastichus,* new to the United States, on sweetclover infected with wound tumor virus. Phytopath. 44:548-50.

SOME NOTES ON SAPYGID PARASITISM IN THE NESTS OF CARPENTER BEES BELONGING TO THE GENUS *XYLOCOPA* LATREILLE

(Hymenoptera: Aculeata)

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Among the many carpenter bee nests investigated by us during the past nesting season only one was found to be parasitized by the sapygid wasp, *Polochrum fallax* Burmeister. Records of parasitism by wasps of this family in the nests of the genus *Xylocopa* are few in number. Historically, Gené (1844) was the first to discover this relationship. For several years, he writes, he had observed in the abandoned nests of the Palaearctic *Xylocopa violacea* (Linnaeus) puzzling empty cocoons. These cocoons, ovoid in shape (6.5 × 17 mm.), were shiny black, rough, and very thin walled. Eventually their identity was solved when he received from Prof. Giammaria Zendrini of the University of Pavia two wasps, *Polochrum repandum* Spinola, together with their associated cocoons. Subsequently, this same wasp has been reported from the nests of *X. violacea* by Gerstaecker (1861), Giraud (1863), Berlese (1923), and Parker (1926). Cocoons of this same wasp also have been found by Malyshev (1931) in the nest of the Palaearctic *X. valga* Gerstaecker. In the New World, Jörgensen (1909, 1912a, b) has recorded *Polochrum fallax* Burmeister as parasitic in the nests of *X. brasilianorum* (Linnaeus) and *X. splendidula* Lepeletier. Some of the foregoing accounts have been mentioned by Friese (1923), Malyshev (1931), and Pate (1947) who placed the New World species of *Xylocopa* parasitizing Sapygidae in the genus *Huarpea*.

Parker (1926: 268-270) has provided the most informative study thus far made of parasitism by the genus *Polochrum* in the nests of *Xylocopa*. His studies were founded on a parasitized nest of *X. violacea* that had been constructed in the dry flower scape of *Agave* near Hyères, France. The first instar larva of *P. repandum* was found on the provisioned pollen mass with the egg of *Xylocopa*. Since on several occasions Parker had noticed a larva of *Polochrum* with the dead egg of *Xylocopa*, he reasons that the egg of *Xylocopa* is killed by the wasp larva which then feeds on the pollen mass. He states that after the wasp larva completes its development, a large dark cocoon is constructed and during the month of July the adult wasp is formed within. Whether the wasps emerge immediately or remain within the cocoon until the following spring he was unable to determine. Of particular value are the descriptions and illustrations he provides of the first and last larval instars of the wasp as well as a characterization of the

[1] The authors wish to acknowledge aid from the Campanha Nacional de Aperfeiçoamento de Pessoal de Nível Superior, the Conselho Nacional de Pesquisas, Rio de Janeiro, and the Instituto de Pesquisas da Universidade do Paraná, Curitiba, Brasil.

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egg. The cocoons of *P. repandum* have been excellently illustrated photographically by Malyshev (1931: 785).

Apart from the remarks of Jörgensen (1909: 59; 1912: 279, 314) reporting that he had found *Polochrum fallax* Burmeister in the nests of *X. brasilianorum* and *X. splendidula,* the only other information on this American species of *Polochrum* in the nests of *Xylocopa* is his comment (1912: 138) that its large, shiny black cocoon measured 7 × 13 mm. In view of the fact that his observations were made in the Province of Mendoza, Argentina, the carpenter bee identified by him as *X. brasilianorum* is either *X. mendozana* Enderlein or *X. ordinaria* Smith, *sensu* Brèthes (1916: 408-409)—or a mixture of these species.

During an enjoyable stay with Prof J. J. Bigarella and his family at their beach home in Caiobá, Paraná, Brazil, a nest of *X. brasilianorum* was located in a sound, unhewn *Sassafras* fence post on January 22, 1960. This nest when split open was found to be parasitized by *Polochrum fallax* Burmeister. The total vertical length of the nest measured 23.8 cm., the lower half of which is shown in Figure 1. The very nearly circular entrance of the nest (13 mm. in diameter) faced southeastward and was situated

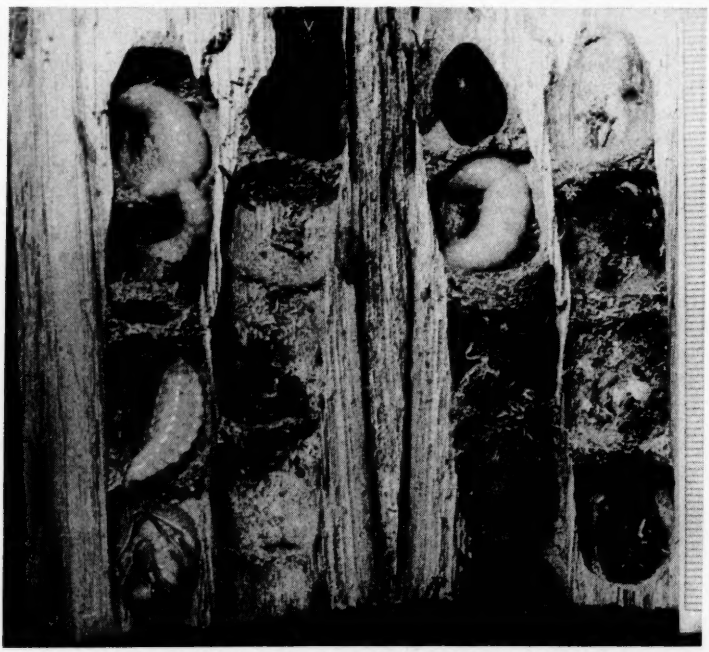

FIG. 1. Counterpart longitudinal sections of the lower half of a nest of *Xylocopa brasilianorum* (Linnaeus) parasitized by *Polochrum fallax* Burmeister. (See text for details.) Left to right, cell series A, B; B′, A′. Scale at right is in millimeters.

82 cm. above the ground. The burrow, leading directly inward from the entrance, had been cut through 7 mm. of bark before it reached the relatively soft wood of the dry fence post. Almost immediately the burrow widened into an irregular vestibule (V, Fig. 1) from which extended upward an empty tunnel which measured 14.4 cm. in length and had an average diameter of 18 mm. Another tunnel, whose opening was situated on the rear wall of the vestibule (27 mm. from the exterior nest entrance), left the inclined floor of the vestibule and turned immediately downward. This burrow, 9.8 cm. in length, contained five cells (Fig. 1, cell series B, counterpart B′) of which the lowermost cell was partly destroyed in the sawing process. One other tunnel, which left the upper right rear wall of the vestibule, immediately turned upward and downward in very close approximation to the tunnel containing cell series B-B′. The lower part of the tunnel contained four cells (Fig. 1, cell series A, counterpart A′) and the upper part of the tunnel, where the nest founding *Xylocopa* female (frayed wings, worn mandibles) was located, measured 8.5 cm. in length and had an average diameter of 16.5 mm. Construction details and measurements of the two cell series (A-A′, B-B′) in the lower half of the nest below the vestibule (V) are directly observable in Figure 1.

As may be seen, cell series A-A′ contained in descending order, a mature *Xylocopa* larva, followed by a *Polochrum* larva in each of the two successive cells, and, in the lowermost cell, a male *Xylocopa* pupa. Cell series B-B′ held in the same order a *Polochrum* cocoon (silken shroud removed), a mature *Xylocopa* larva, and a *Polochrum* cocoon in each of the three following cells. From an examination of the fecal pellets in the cells with *Polochrum* larvae it is not clear whether they had developed on the pollen mass or on the *Xylocopa* larvae. No recognizable *Xylocopa* larval exuviae were found in these cells. It is possible that this question may be resolved by an examination of the ailmentary canal of the two *Polochrum* larvae which have been preserved for subsequent larval studies.

The cocoons of the *Polochrum,* normally at least partly shrouded in loosely spun silk, are firmly anchored to the lower end wall or partition of the cell by means of a tightly spun silken foot. The wall of the cocoon, 0.2 mm. thick, is very tough, stiffly pliable, and irregular in surface texture. It is not very easily crushed and like a partly inflated football to which exterior pressure is alternately applied and released, it tends to resume its original shape. The inner wall of the cocoon is lined with a thin layer of silk. Two of the cocoons, partly opened on March 15, each contained a larva which promptly spun a silken window across the excised aperture.

LITERATURE CITED

Berlese, A. 1923. Gli insetti. Milano, 2:558, fig. 613.

Brèthes, Jean. 1916. Le genre "Xylocopa" Latreille dans la République Argentine. Physis, 2:407-421.

Gené, G. 1844. Memoria per servire alla storia naturala di alcuni Imenotteri. Mem. Mat. Fis. Soc. Ital. Sci., 23(2):30-62 (1842).

Gerstaecker, A. 1861. Ueber die gattung Sapyga Latr. Stettiner Ent. Zeitg., 22:309-322.

Giraud, J. E. 1863. Note sur quelques Hyménoptères tres rares découverts en Autriche, et description d'un chalciden nouveau *(Dirrhinus imperialis)*. Verh. K. K. Zool.-Bot Gesellsch., 13:1306-1312.

Friese, H. 1923. Die europäischen bienen. Berlin and Leipzig: Walter de Gruyter & Co., vi + 456 pp., 100 figs., 33 pls. (in color).

Jörgensen, P. 1909. Beobachtungen über blumenbesuch, biologie, verbreitung usw. der bienen von Mendoza. (Hym.). Deutsche Ent. Zeitschr., pp. 53-65; 211-227.

———. 1912a. Los Crísididos y los Himenópteros Aculeatos de la Provincia de Mendoza. An. Mus. Nac. Buenos Aires, ser. 3, 22(15):267-338 (1911).

———. 1912b. Revision der Apiden der Provinz Mendoza, Republica Argentina (Hym.). Zool. Jahrb. Abt. Syst., 32:89-162, 8 text figs.

Malyshev, S. J. 1931. Lebengeschichte de Holzbienen, *Xylocopa* Latr. (Apoidea). Zeitschr. Morphol. Ökol. Tiere, (A)23(3-4):754-809, 15 figs.

Parker, H. 1926. Note sulla larva del *Polochrum repandum* Spinola (Hym. Sapygidae) parassita della *Xylocopa violacea* L. Boll. Lab. Zool. Gen. Agr. Portici, 18:268-270, 6 figs. (1924).

Pate, V. S. L. 1947. Neotropical Sapygidae, with a conspectus of the family (Hymenoptera: Aculeata). Acta Zool. Lilloana, Tucuman, 4:393-426.

BIOLOGICAL NOTES ON *CULISETA MINNESOTAE* BARR AND *CULISETA MORSITANS* (THEOBALD) (Diptera: Culicidae)[1]

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Since the description of *Culiseta minnesotae* from adult specimens by Barr (1957) and the subsequent discussion of the larval and pupal stages by Price (1958), there has been no information offered on the biology of this species. The known distribution of *C. minnesotae* has been extended recently, however, by Burbutis and Lake (1959), who recorded the capture of one larva in 1955 and 318 females in light traps during the summer of 1956 in New Jersey, and by Nielsen and Rees (1959), who reported two collections of adults and larvae in 1956 in Weber County in northern Utah. Coupled with a description of both the male and female of this same species included under the name of the closely related *C. morsitans* (Theobald) by Stage *et al.* (1952) in the northwestern states, this extends the present distribution of *C. minnesotae* from coast to coast across the northern portion of the United States.

The literature on the biology of *C. morsitans,* at least in the United States, may well include a composite of the biologies of both this species and the recently-separated *C. minnesotae* and this has contributed to the necessity of conducting a search for biological differences that might exist between these two species. This could take on added significance if one considers, for example, the feeding habits of *C. morsitans* and *C. minnesotae* and the possible role of these species in the epidemiology of viral encephalitides. Much of the material that follows has been gathered by the author

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in his studies of the Minnesota mosquitoes during the past four years; it is presented here in the hope that some insight, albeit of a preliminary nature, may be gained on the comparative biologies of these two species and that this will stimulate others to contribute to this subject.

During intensive larval collecting in the springs of 1957, 1958, and 1959 at Itasca State Park, Clearwater Co., Minn., 67 collections from 16 different habitats yielded 672 larvae of *C. morsitans* and 11 collections from five habitats produced 66 *C. minnesotae* larvae. From this the general impression was formed that *C. morsitans* larvae consistently occurred among the early collections, in conjunction with the single-brooded spring *Aedes; C. minnesotae* larvae appeared only as the season progressed and as the production of the multi-brooded summer species began. This point is illustrated in Figure 1 in which the average stage of development of the species at each collection is plotted against the date on which the collection was made. This average figure was derived by giving values of 1, 2, 3, and 4 to each larva of the respective instar and 5 to each pupa and then dividing the sum by the number of individuals.

C. morsitans was associated with larvae of the same or slightly advanced developmental stages of 14 species of *Aedes*. These species and the number of habitats in which the associations occurred were as follows: *Aedes abserratus* (Felt & Young) (4), *Ae. barri* Rueger (16), *Ae. canadensis* (Theobald) (4), *Ae. cinereus* (Meigen) (21), *Ae. diantaeus* (Howard, Dyar, & Knab) (9), *Ae. excrucians* (Walker) (24), *Ae. fitchii* (Felt & Young) (16), *Ae. intrudens* Dyar (4), *Ae. punctor* (Kirby) (7), *Ae. riparius* Dyar & Knab (2), *Ae. sticticus* (Meigen) (1), *Ae. stimulans* (Walker) (4), *Ae. trichurus* (Dyar) (5), and *Ae. vexans* (Meigen) (2). It should be noted that all of these species represent mosquitoes that overwinter in the egg stage. Moreover, in addition to these, *C. morsitans* was associated with younger larvae of *Culex territans* Walker (3), *Culiseta inornata* (Williston) (2), *C. minnesotae* (1), *Anopheles earlei* Vargas (3), *An. punctipennis* Say (2), and *An. walkeri* Theobald (1). Most of these are said to overwinter as hibernating females and to breed more or less continuously throughout the summer.

The larvae of *C. minnesotae* were associated with larvae of approximately the same developmental stages of *C. territans* (4), *C. inornata* (1), *An. earlei* (1), *An. punctipennis* (1), and *An. walkeri* (1). The associates that were much further along in their development were *Ae. barri* (1), *Ae. cinereus* (1), *Ae. excrucians* (2), and *Ae. fitchii* (1).

From July 19 to August 14, 1956, in the northern St. Paul area, Ramsey Co., Minn., 20 larvae of *C. minnesotae* were collected in five visits to one habitat; these represented the first discovery of the immature stages of this species and provided the material for the larval and pupal descriptions (Price, 1958). The period of June 18 through September 12, 1957, yielded 40 additional larvae of the same species on eight occasions from two habitats, one of these the same as that of the previous year. In collections during the spring of 1957 about 35 miles north of St. Paul in the Cedar Creek Natural History Area, Isanti Co., Minn., 45 *C. morsitans* larvae were found in 11 collections from four habitats and 44 *C. minnesotae* occurred in six collec-

tions from two habitats. The larval associates in all of the above generally agreed with the types found for each of the *Culiseta* species at Itasca.

The Metropolitan Mosquito Control District commenced operations in 1958 in the six-county area surrounding Minneapolis and St. Paul and, in conjunction with this, conducted an intensive survey that year for larval breeding areas. Through the courtesy of Mr. A. W. Buzicky, the district director, the dates for 166 collections of larval *C. minnesotae* and six of *C. morsitans* were furnished for inclusion in this paper. This information has been combined with the 30 observations made in this same area by the writer and presented in Figure 2.

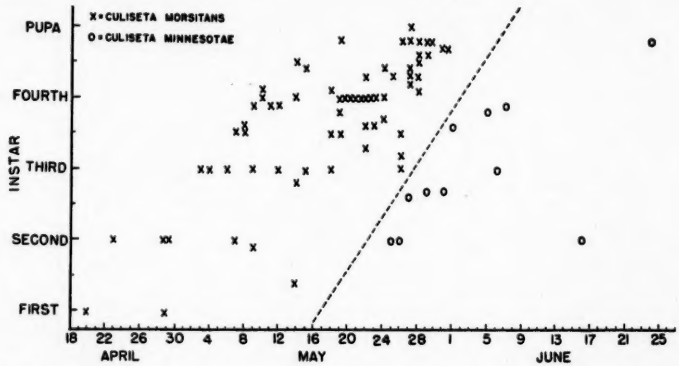

FIG. 1. Average Stage of Development of *Culiseta morsitans* and *Culiseta minnesotae* on Each Collection Date at Itasca State Park, 1957-1959.

All of the habitats in which *C. minnesotae* has been found were of the exposed semi-permanent to permanent sedge-cattail marsh category. *C. morsitans* enjoyed a somewhat wider distribution, inhabiting not only the same marshy sites as *C. minnesotae* but also such places as tamarack swamps and the more sheltered woodland or coniferous pools and marshes. The larvae of both species tended to be located adjacent to vegetation in the water. Experience has shown that they easily may be overlooked during the routine collection of other larvae unless one takes special care to dip water directly from the center of or around the edges of emergent vegetation, especially the dense clumps of grasses or sedges so common to many habitats.

In only two sites studied to date have both *C. minnesotae* and *C. morsitans* occurred during the same season. In both instances, one at Cedar Creek and the other at Itasca, the last larvae of *C. morsitans* were observed from May 23-29; they were all late fourth-instar and obviously approaching pupation. Coincident with this finding, second- and third-instar larvae of *C. minnesotae* were observed from May 23-27; they reached third- and fourth-instar levels during the first week of June and probably did not begin pupating until around June 10, or two weeks after the last stragglers of

C. morsitans had pupated. The disappearance of the *C. morsitans* larvae coincided with that of certain early *Aedes* species; the development of *C. minnesotae* paralleled especially that of *C. territans* and several others of similar habits.

Based upon the Itasca observations in Figure 1, the length of larval life of *C. morsitans* is estimated to range from four to six weeks. The larval stages of *C. minnesotae* probably pass by more rapidly, this being principally a reflection of the warmer waters later in the season. A few specimens of this latter species have been reared from third or early fourth instar larvae to adults in the laboratory. Under conditions of continual aeration in pond

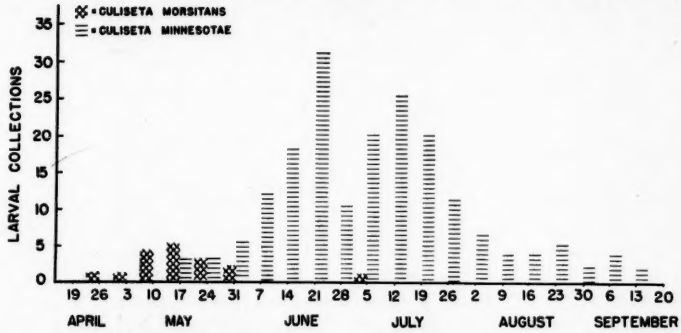

FIG. 2. Weekly Seasonal Distribution of 202 Collections of Larvae of *Culiseta morsitans* and *Culiseta minnesotae* in the Minneapolis-St. Paul Area, 1956-1958.

water kept at laboratory temperature and with no additional food provided, the fourth-instar stage lasted four to six days and the pupal stage, two to three days.

Many European workers (*e.g.*, Natvig, 1948) believe that *C. morsitans* overwinters chiefly in the late larval instars; no confirmation of this type of cycle has been reported in North America. The larval seasonal distributions as given in Figures 1 and 2 indicate an overwintering of this species, at least in Minnesota, either as an egg or as an inseminated female. In support of the former idea, the eggs of *C. morsitans* are said to be laid singly and to be able to withstand desiccation for weeks, probably months (Shute, 1933). Martini (1930) and Callot and Ty (1944) further postulate that this species in Europe may overwinter as an egg in addition to the larval form. Howard *et al.* (1915), from observations in the United States, state that probably the egg is deposited singly and that the late summer and all winter is passed in this stage. The egg of *C. morsitans* would thus seem to be more like an *Aedes* egg than like that of the raft-forming *Culiseta* and *Culex* species. If, on the other hand, *C. morsitans* hibernates as a female, then the life cycle would be similar to the *Culiseta impatiens* type of cycle as reported by Frohne (1954) in Alaska. This would involve for *C. morsitans* a single-broodedness with an extremely long-lived female capable of living from May or June of one year through the vicissitudes of both summer and winter to late April of the next year. A cycle of this nature would be unique

among Minnesota mosquitoes, but this in itself would not preclude its occurrence. Should one assume the female to overwinter, then the larval associates reveal that she must become active distinctly earlier than any of a number of other species of similar hibernation habits. The homogeneity of larval age class within any specific habitat indicates the hatching of either a group of submerged overwintering eggs or of recently-inundated eggs laid early that spring by hibernating females. In spite of the fact that the rather inconclusive evidence to date may be construed to fit either method of overwintering as outlined above, the present author tends to favor the overwintering egg hypothesis to that of the hibernating female; only further work will show the validity of making such an assumption. Regardless of how overwintering is accomplished, most studies, including the present one, agree that there is only a single generation each year.

Contrasted to the above, *C. minnesotae* appears to be more conventional in its type of life cycle. The larval collections as well as light trap samplings indicate a continual breeding of this species throughout the late spring, summer, and early fall (see Fig. 2); it is probably the females produced in the later part of the season that contribute to the overwintering population. Of the 83 specimens taken by two light traps during four years of operation in the St. Paul area, all but one specimen (on June 12) were captured between July 4 and September 30. Barr (1957) reported the capture from May 2-7, 1953, of what he believed to be old, overwintered females of this species; the life cycle as postulated here is in agreement with this finding. He did, however, state that adults had been taken only from April to June and from September to October; on the basis of our present knowledge, the occurrence of adult *C. minnesotae* should be broadened to include the entire period from spring to fall.

LITERATURE CITED

Barr, A. R. 1957. A new species of *Culiseta* (Diptera: Culicidae) from North America. Proc. Ent. Soc. Wash., 59:163-167.

Burbutis, P. P. and R. W. Lake. 1959. New mosquito records for New Jersey. Mosq. News, 19:99-100.

Callot, J. and D. V. Ty. 1944. Contribution a l'étude des moustiques français culicides de Richelieu (Indre-et-Loire). Ann. Parasit. hum. comp., 20:43-66.

Frohne, W. C. 1954. Mosquito distribution in Alaska with especial reference to a new type of life cycle. Mosq. News, 14:10-13.

Howard, L. O., H. G. Dyar and F. Knab. 1915. The mosquitoes of North and Central America and the West Indies. Vol. III. Systematic description. Part I. Carneg. Inst. Wash., Publ. No. 159, vi+523 pp.

Martini, E. 1930. Culicidae. *In* Lindner, E., Die Fliegen der palaearktischen Region. 11-12:1-398.

Natvig, L. R. 1948. Contributions to the knowledge of the Danish and Fennoscandian mosquitoes. Culicini. Norsk. Entom. Tids., Suppl. 1, xxii+567 pp.

Nielsen, L. T. and D. M. Rees. 1959. The mosquitoes of Utah—a revised list. Mosq. News, 19:45-47.

Price, R. D. 1958. A description of the larva and pupa of *Culiseta (Culicella) minnesotae* Barr (Diptera, Culicidae). Jour. Kansas Ent. Soc., 31:47-53.

Shute, P. G. 1933. The life-history and habits of British mosquitoes in relation to their control by antilarval operations. Jour. Trop. Med. Hyg., 36:83-88.

Stage, H. H., C. M. Gjullin, and W. W. Yates. 1952. Mosquitoes of the northwestern states. U.S. Dept. Agric., Agric. Handbk. No. 46, 95 pp.

FOUR NEW SPECIES OF *HYDROMETRA* FROM THE NEW WORLD[1] (Hemiptera: Hydrometridae)

STEPHEN MYCHAJLIW

In the course of a study of the Hydrometridae in the Francis Huntington Snow Entomological Museum of the University of Kansas four new species were found and are described below.

The Snow Museum contains many of the types of Hungerford, Hungerford and Evans, Torre-Bueno and Kirkaldy. Thanks to the kindness of Dr. C. J. Drake, who has described ten species of *Hydrometra,* I was privileged to go to Ames, Iowa, and study his types. Dr. R. I. Sailer of the United States National Museum examined certain types that were there and answered my inquiries concerning them. I am grateful to all who have made it possible for me to recognize these new species; especially I am thankful to Dr. H. B. Hungerford, under whose direction this work has been carried out, for his patience, encouragement and helpful criticism.

In this study I used a Spencer binocular equipped with 9X ocular and 6.8X objective. Of the linear micrometer scale in the ocular 100 units=1.45 mm. In describing the head of *Hydrometra* the AO=anteocular length and PO=the postocular length and the formula expresses the relative position of the eyes on the head.

Hydrometra beameri n. sp.

Size. Length 12.5 mm.

Color. Yellowish to light brown from dorsal aspect. Sides, yellowish to light brown, ventral side of head dark brown to nearly black. Thoracic and abdominal venter light to dark brown. Abdominal tergites yellowish to brown. Their lateral margins dark brown.

Structural characteristics. Head: 262 units long. AO:PO::160:80. Eyes 22 units long. Antennal formula: I:II:III:IV::50:70:220:100. Rostrum extends beyond the eyes to nearly half the PO distance. Interocular groove shallow on dorsal side and much deeper and longer than the eyes on ventral side. Clypeus slightly longer than broad, constricted at the base, distal two fifths narrowing to a truncated anterior margin.

Thorax: Pronotum 140 units long, with one row of shallow pits parallel to its anterior margin. Metanotum 140 units long. Wings strap-like, extending over first tergite of abdomen. Distance between first and second coxae 70 units, between second and third coxae 140 units. First acetabulum with five pits anterior and six posterior to cleft. Second acetabulum with four pits anterior and five posterior to cleft. Third acetabulum with six pits, very faint. Front femora almost reaching tip of head. Hind femora not reaching tip of abdomen.

Abdomen: 375 units long. An elevation, with a tuft of short hairs, anteriorly and close to the intersegmental line of each side of venter of last abdominal segment of male. First genital segment with some fine hairs on distal half of its venter. Last abdominal segment two thirds as long as

[1] Contribution No. 1083 from the Department of Entomology, University of Kansas.

preceding segment (40:60). Length of venter of last abdominal segment is to length of venter of first genital segment as 30:20.

Types. Described from two brachypterous male specimens collected by L. D. Beamer on January 3, 1950, in El Naranjo, Tamaulipas, Mexico. Named in honor of Dr. R. H. Beamer, former curator of the Snow Entomological Museum. Types deposited in the Snow Entomological Museum, The University of Kansas, Lawrence, Kansas. Another male, fully winged, not designated as a paratype, from Progreso, Texas, July 1, 1938 (R. I. Sailer) is also in the Snow Museum.

Comparative Notes. Related to *H. priscillae* Torre-Bueno in the character of its integument which is smooth yellowish or light brown. However, the mammilose processes on the venter of the last abdominal segment of the male are like those of *H. fruhsdorferi* H. & E., which has a rough black integument. These processes in *H. beameri* are smaller, nearer the lateral margins and close to the anterior margins of the segment.

Hydrometra thomasi n. sp.

Length. 8.5 mm.

Color. Macropterous forms with head and thorax yellowish brown, latter with a transverse row of about ten white pits behind the anterior margin; anterior lobe of pronotum covered with black spicules except for a median longitudinal space which is devoid of spicules; laterally there is a convexly curved, silvery or pale line above the front acetabula; posterior lobe of the pronotum with few spicules but covered with white pits. Hemelytra with yellowish to brownish veins, membranous parts brown mottled with lighter brown; no white longitudinal line on hemelytra. Brachypterous forms with paler aspect; posterior lobe of pronotum smaller but with some black spicules as well as white pits. Exposed abdominal tergites reddish brown bordered with dark brown; connexivum yellow with brownish margin; abdominal spiracles marked by white spots in a brown band.

Structural characteristics. Head: 165 units long. AO:PO::93:52. Length of eyes 17 units. Antennal formula: I:II:III:IV::37:48:130:105. First antennal segment much thicker on distal half, dark brown distally and yellowish proximally. Second segment slender, yellow, tipped with dark brown. Dorsal interocular groove shallow; ventral groove much deeper. Length of rostrum 155 units, extending to two-thirds of the PO. Clypeus short, compressed at the base, bluntly pointed anteriorly.

Thorax: Pronotum 105 and metanotum 80 units long. Distance between first and second coxae 50 units; between second and third coxae 80 units. All acetabula pitted. First acetabulum with six pits anterior to the cleft and seven posterior to it. Second acetabulum with seven pits on each side of cleft. Third acetabulum with nine pits. Front femora almost reaching tip of head, hind femora surpassing apex of abdomen by almost one eighth of their length.

Abdomen: 245 units long. Venter of last abdominal segment slightly inflated, covered with long hairs. First genital segment laterally compressed ventrally to form a broad flat keel. Near caudal end of this keel, on either side, is a laterally directed clump of spines. Suranal plate with a short

caudal spine directed backwards, covered with spicules. In macropterous male, wings extend to base of last abdominal segment. In micropterous males, wings short and extending to middle of first abdominal segment. Ratio of length of venter of last abdominal segment to venter of first genital segment::30:25.

Types. This species is described from three males collected by Henry Thomas in 1938 and one male taken by Irwin Slesnick in 1953. The holotype (macropterous) and one paratype (brachypterous) from Guadalajara, Jalisco, Mexico, September 10, 1938 (H. D. Thomas); a second paratype (brachypterous) from Chapala, Jalisco, Mexico, September 11, 1938 (H. D. Thomas). The other paratype (macropterous) from three miles W. of Jacona, Michoacan, Mexico, July 18, 1953, 5300 ft. (University of Kansas Mexican Expedition; Slesnick field no. 53). All types are in the Francis Huntington Snow Entomological Museum at the University of Kansas.

Comparative notes. There are several species in which the venter of the first genital segment of the male is laterally compressed to produce a ventral keel, *e.g. H. huallagana* Drake, *H. exilis* Torre-Bueno, and *H. cordubense* Torre-Bueno. None of them, however, has lateral expansions at the caudal end of the keel capped by laterally directed spines, as is true of *H. thomasi.*

Hydrometra ciliata n. sp.

Size. Male 9.0 mm., female 10.5 mm. long.

Color. Same as that given above for *Hydrometra thomasi,* except in macropterous forms, which have the membranous part of the hemelytra paler, the mottling less distinct, the lighter markings nearly white. Abdomen slightly darker than remainder of body, somewhat darker on the sides, becoming darker towards posterior end.

Structural characteristics. Head: 190 units long. AO:PO::115:58. Length of eyes 17 units. Antennal formula: I:II:III:IV::40:64:220:112. First antennal segment slightly thicker on distal end, dark brown in color and covered with short fine hairs. Second antennal segment also covered with short fine hairs. Dorsal interocular groove deep. Ventral interocular groove slightly deeper than dorsal groove. Clypeus narrow, bluntly pointed, elongated and slightly constricted at base. Rostrum extends backward to midlength of PO.

Thorax: Pronotum 108 units long. Anterior lobe of pronotum with a median, dorsal, faint, pale line which extends foreward into a transverse row of white, deep pits. This row of pits parallel to anterior margin of pronotum. Pits present on both sides of propleura. Metanotum 85 units long, covered by hemelytra, which extend to base of last abdominal segment. Color of hemelytra light brown with cinnamon veins. Distance between first and second coxae 50 units, between second and third coxae 90 units. All acetabula with pits. First acetabulum with (left) five pits anterior to cleft and five posterior to it. Second acetabulum with four pits anterior and six posterior to cleft. Third acetabulum with seven pits. Second acetabulum of right side cannot be seen. First acetabulum (right) with five pits anterior and six posterior to cleft. Third acetabulum with nine pits. This shows that there is some variation in the pitting. Front femora as long as head. Hind femora slightly surpassing tip of abdomen.

Abdomen: 260 units long. Dorso-ventral diameter of caudal half of fifth abdominal segment of male decreased to equal that of sixth abdominal segment. Median ventral area of fifth and sixth abdominal segments free of spicules, yellow in color, forming a triangle, the base of which is on the posterior edge of sixth abdominal segment. A few scattered long hairs present on venters of abdominal segments. A group of long, curved hairs near the caudolateral margins of last segment, behind which, on anterior margin of first genital segment, are denser tufts of curved hairs. First genital segment ventrolaterally compressed. Lateral depressed areas covered with fine brown hairs. Genital segment in ventral aspect with a keel, broader on anterior and posterior ends. Dorsal suranal plate of male pointed and turned up slightly, covered with fine hairs. Second genital segment (capsule) covered with fine hairs.

Types. Described from three males and three females from Mexico. Holotype, a macropterous male, from Puente de Ixtla, Guerrero, Mexico, July 12, 1937 (H.D. Thomas). Allotype, a brachypterous female from Guerrero, Tierra Colorado, 377 Km. S. Mexico City, October 31, 1936 (H. D. Thomas). Paratypes, one macropterous female, University of Kansas Mexican Expedition, 6 miles N.E. Villa Union, Sinaloa, Mexico, July 21, 1953, 100 ft. elevation (Slesnick field no. 66) and three macropterous specimens, two males and one female, Cibuta, Sonora, Mexico (F. S. Truxal). Holotype, allotype and one paratype in the Francis Huntington Snow Entomological Museum, The University of Kansas; one paratype in the C. J. Drake collection at the U.S. National Museum, Washington D.C. and two paratypes in the Los Angeles County Museum, Los Angeles, California.

Comparative Notes. This species is quite closely related to *H. thomasi.* Its first antennal segment is much more slender. The venters of the caudal half of the fifth and all the sixth abdominal segments of the male are flattened. They are not in *H. thomasi.* The venter of the last abdominal segment of the male is not covered with long hairs as it is in *H. thomasi,* and the ventral keel of the first genital segment lacks the spiniferous lateral protuberances of *H. thomasi.*

Hydrometra olallai n. sp.

Size. Males 14.5-15 mm., females 16-19 mm. long.

Color. Macropterous forms: Head brown to nearly black. Anterior collar of pronotum dark brown, which may or may not include the transverse row of pits, which are sometimes white. Anterior lobe of pronotum otherwise without pits and brown in color, posterior lobe pitted and usually yellowish with a median longitudinal purple band that may or may not enclose a frosty line. Hemelytra dark brown with darker veins and no white spots or lines. Exposed abdominal tergites brown, connexivum yellow. Abdominal pleuron with or without a longitudinal brown band. Micropterous forms: Head and thorax as above; males with narrow abdominal tergites dark brown and connexivum yellow with a brown margin.

Structural characteristics. Head: 358 units long. AO:PO::245:83. Length of eyes 28 units. Antennal (allotype) formula, I:II:III:IV::57:155:420?:402? in male and 55:118:400:130 in female. Rostrum short, barely reaching eyes. Interocular grooves shallow and short on dorsal side, deep and long on

ventral side. Clypeus elongated, sides parallel, anterior edge pointed.

Thorax: Pronotum (brachypterous) 152 units long. Transverse row of pits behind anterior margin. Otherwise anterior margin. Otherwise anterior

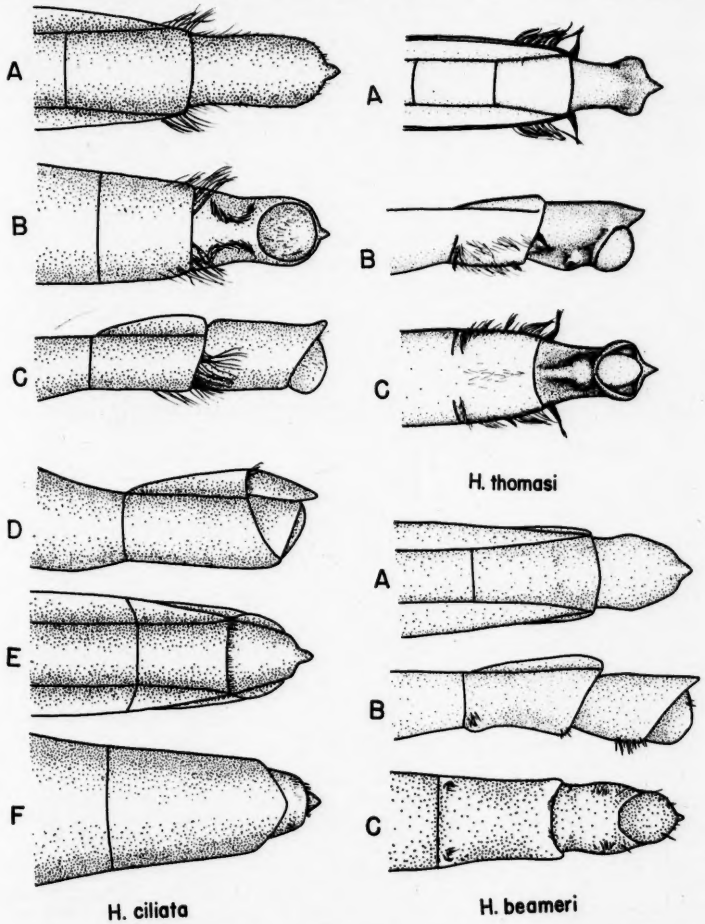

PLATE I. *Hydrometra ciliata* n. sp. A. Last abdominal and genital segments of male as seen from above. B. Ventral view of same. C. Lateral view of same. D. Lateral view of last abdominal and genital segments of female. E. Dorsal view of same. F. Ventral view of same. *Hydrometra thomasi* n. sp. A. Dorsal view of last two abdominal segments and genital segments of male. B. Lateral view of same. C. Ventral view of same. *Hydrometra beameri* n. sp. A. Dorsal view of last abdominal segment and first genital of male. B. Lateral view of same. C. Ventral view of same.

lobe of pronotum without pits, posterior lobe with scattered pits. Metanotum 135 units long. Wings in brachypterous forms pad-like, extending to base of abdomen. In winged female, wings reaching middle of fifth abdominal segment. In male distance between first and second coxae 77 units, between second and third coxae 140 units. Acetabula all pitted. First acetabulum with seven pits anterior to cleft and six posterior to it. Second acetabulum with seven pits anterior and eight posterior to cleft. Third acetabulum with eight pits. In holotype, front femora extend beyond apex of head by about 60 units and hind femora extend beyond apex of abdomen by one fourth of their length.

Abdomen: Length of male 420 units, allotype female 440 units. Venter of last abdominal segment of male slightly depressed in the middle. Two obliquely placed elevations covered by black, shiny hairs situated one at either side of sixth abdominal sternum, one fourth of length of this sternite from its anterior margin. First genital segment with a slight elevation covered by short hairs on each side of the segment at about midlength. Dorsal, terminal spine of suranal plate of male short, blunt, and slightly decurved. Suranal plate of female somewhat shorter than the preceding segment (50:60), declivent, narrowing distad, with a short, sharp spine. Length of venter of sixth abdominal segment of male is relative to length of first genital segment as 35:25. This species is named in honor of the collector, A. M. Olalla.

Types. This species is described from the holotype, a brachypterous male, the allotype, a macropterous female, both from Manaos, Brazil, December, 1935 (A. M. Olalla), and the following paratypes bearing the same data: one brachypterous male, three bachypterous females, nine macropterous females. A second group of paratypes, one brachypterous male and 21 brachypterous females, are from the Amazon River, Region of Itacoatiara, Brazil, January-April 1936. (A. M. Olalla). A third group of paratypes, one brachypterous male and eight brachypterous females, are from the Amazon River (Lur.), Region of Lago Tapaiuna, Brazil, January-April, 1936 (A. M. Olalla, No. 7). Besides we have one macropterous and five brachypterous females from Vic. João Pessoa (San Philipe), Rio Jurna, Brazil, July 10, Sept. 20, 1936 (A. M. Olalla, No. 376); one large brachypterous female from Vic. Santo Antonia, Rio Eiru, Brazil, Sept. 25, Oct. 17, 1936 (A. M. Olalla, No. 3715).

The last-mentioned specimen may be *H. olallai;* another, No. 3713, a macropterous female, is not *H. olallai;* and two brachypterous females, No. 3714, are too small for *H. olallai.*

Comparative notes. This is a large species, as are *H. metator* White, *H. caraiba* Guér., *H. guiana* H. and E., *H. williamsi* H. and E., and several others. It seems most useful to compare it with *H. metator,* which was described from Uricaco, Rio Jurna, Brazil. The beak of *H. metator* is very short (82% of AO), not reaching the eyes by about one fifth of AO, whereas in *H. olallai* the beak just reaches the eyes, as it does also in *H. caraiba.* In both *H. metator* and *H. caraiba* the venter of the last abdominal segment of the male has a long series of short bristles that form a complete oval in *H. metator* and a crescent in *H. caraiba,* whereas in *H. olallai* the venter of

the last abdominal segment has two oblique lateral elevations capped by tufts of short bristles, and on the side of the first genital segment there is an elevated tuft of bristles which is lacking in the other two species.

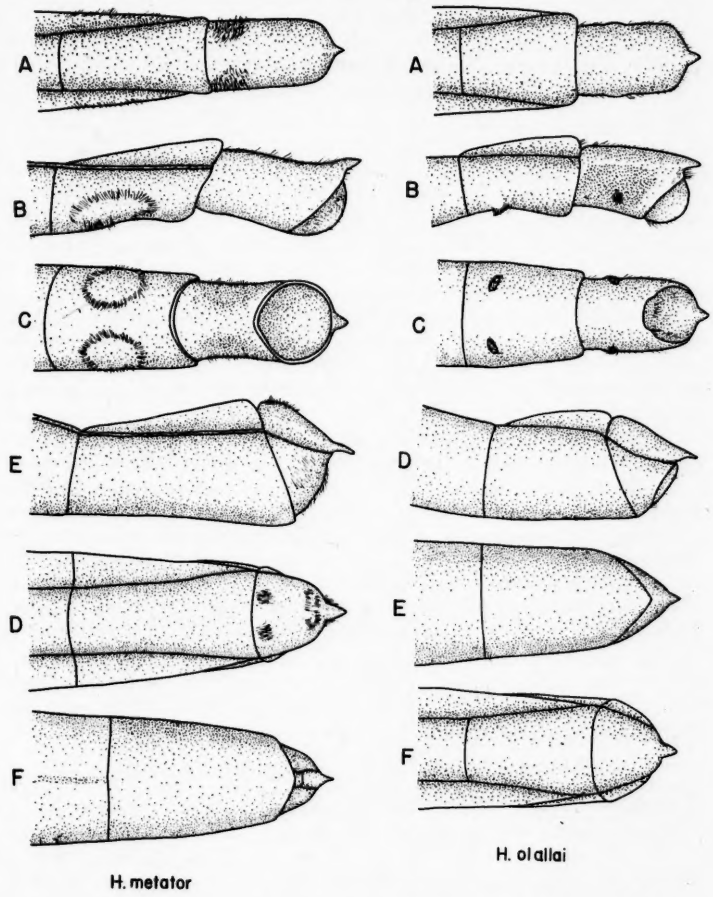

PLATE II. *Hydrometra metator* White. A. Dorsal view of last abdominal and first genital segment of the male. B. Lateral view of same. C. Ventral view of same. D. Dorsal view of last abdominal segment and genital segment of female. E. Lateral view of same. F. Ventral view of same. Drawings made from specimens compared with the types in British museum by Mr. R. J. Izzard. *Hydrometra olallai* n. sp. A. Dorsal view of last abdominal segment and first genital of male. B. Lateral view of same. C. Ventral view of same. D. Lateral view of last abdominal segment and genital segments of female. E. Ventral view of same. F. Dorsal view of same.

THE GENUS *PENENIRMUS* (Mallophaga) FOUND ON NORTH AMERICAN WOODPECKERS

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The genus *Penenirmus* Clay and Meinertzhagen, 1938, is found on hosts of the avian orders Piciformes and Passeriformes. Among the forms found on the Passeriformes, considerable range in external morphological differences exist. Among the forms found on the Piciformes, external morphological differences are slight. Carriker (1956) and Emerson (1958) considered that the known forms found on North American Piciformes were subspecies of *Penenirmus auritus* (Scopoli, 1763), the first species of the genus described from specimens collected off a woodpecker.

Reported herein are the results of a study of a large number of specimens collected off fifteen of the twenty-two species of woodpeckers found in North America (north of Mexico). The known species found on woodpeckers elsewhere are not discussed in detail but have been included in a key to indicate possible relationships.

External morphological differences believed sufficient to warrant specific rank have been incorporated in a key. Those considered to be of lesser value have been illustrated for the North American forms to facilitate separation of the subspecies. In general appearance, all forms are very similar; therefore complete illustrations have been included for only one form. The following key utilizes the chaetotaxy of the tergites in separating many of the species. This character is fairly reliable, but occasionally a specimen will be encountered which does not possess normal chaetotaxy on the tergites. These specimens can be determined by comparison with the illustrations.

The authors gratefully acknowledge the assistance provided by Dr. Theresa Clay, British Museum (Natural History); Mr. Robert E. Elbel, University of Oklahoma; Dr. H. G. Deignan, U.S. National Museum; and the many individuals who loaned specimens.

Key to the species of *Penenirmus* found on Piciformes

1. Abdominal tergites III-IV-V with an average of four centro-posterior setae each 2
   Abdominal tergites III-IV-V with an average of six centro-posterior setae each 5
   Abdominal tergites III-IV-V with an average of eight centro-posterior setae each 6
   Abdominal tergites III-IV-V with an average of ten centro-posterior setae each ..... *maculipes*
2. Abdominal tergite VIII of female with two centro-posterior setae ..... *serrilimbus*
   Abdominal tergite VIII of female with four centro-posterior setae 3

3. Pterothorax with four centro-posterior setae 4
   Pterothorax with six centro-posterior setae ..... *jungens*
4. Abdominal tergite IX of female with six posterior setae ..... *auritus*
   Abdominal tergite IX of female with eight posterior setae .. *californiensis*
5. Abdominal tergite VII of female with four centro-posterior setae ..... *macrotrichus*
   Abdominal tergite VII of female with six centro-posterior setae .. *villosus*
6. Pterothorax with four centro-posterior setae ..... *pici* and *tuktola*
   Pterothorax with at least six centro-posterior setae 7
7. Mesosternal plate with two posterior setae ..... *heteroscelis*
   Mesosternal plate with four posterior setae ..... *campephili*

Penenirmus auritus auritus (Scopoli, 1763)

Pediculus auritus Scopoli. 1763. Entomologia Carniolica: 383.
Docophorus superciliosus Burmeister. 1838. Handb. Ent., 2:427.

Clay and Hopkins (1951) designated neotypes from specimens collected off the type host, *Dryobates major pinetorum* (Brehm), from Yugoslavia. Neoparatypes were examined during this study.

Diagnosis. The dorsal anterior plate of the forehead is the same shape as, but slightly larger than that of *P. auritus evagans* (Fig. 5). Chaetotaxy of pterothorax is the same as that shown in Figure 20. Posterior margin of female vulva as shown in Figure 23. Clay and Hopkins (1951) have provided other illustrations.

Measurements

	Male	Female
Length of head	0.53 mm	0.57 mm
Breadth of head	0.48	0.50
Breadth of prothorax	0.29	0.30
Breadth of pterothorax	0.46	0.51
Breadth of abdomen	0.60	0.65
Total length	1.72	1.99

Penenirmus auritus evagans (Kellogg, 1896)

Docophorus evagans Kellogg. 1896. Proc. Calif. Acad. Sci., 6:480, pl. 66, fig. 2.

Original description was based on a single male collected off the Downy Woodpecker, *Dendrocopos pubescens medianus* (Swainson), at Lawrence, Kansas. Illustrations are for specimens from the type host collected in Virginia. Other specimens, from the type host, collected in Oklahoma and Indiana were examined.

Diagnosis. Female as shown in Figure 1. Male as shown in Figure 2. Male genitalia as shown in Figure 3. Posterior margin of female vulva as shown in Figure 4. Dorsal anterior plate of forehead as shown in Figure 5. Chaetotaxy of pterothorax as shown in Figure 20. Smaller than the nominate form, and with a different chaetotaxy of the posterior margin of female vulva.

Specimens from the Arizona Woodpecker, *Dendrocopos arizonae* (Hargitt), collected in Chihuahua, Mexico, are considered to be this subspecies.

Penenirmus auritus peusi Eichler, 1953

Penenirmus peusi Eichler. 1953. Zool. Anz., 150:242, figs. 4, 9, 11 and 18.

Described from specimens collected in the Balkans off *Dendrocopos syriacus balianicus* (Gengler and Stresemann). Specimens were not available for study, so this classification is tentative based upon Eichler's illustrations and description.

Penenirmus californiensis californiensis (Kellogg, 1896)

Docophorus californiensis Kellogg. 1896. Proc. Calif. Acad. Sci., 6:483, pl. 66, fig. 6.

Original description was based on specimens collected off the Acorn Woodpecker, *Melanerpes formicivorus bairdi* Ridgway, at Palo Alto, California. Illustrations and measurements are for specimens off *Melanerpes formicivorus formicivorus* (Swainson), collected in Arizona. Two female syntypes were also examined.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 7, chaetotaxy of pterothorax as shown in Figure 16, and posterior margin of female vulva as shown in Figure 25 are distinctive. Other characters, except measurements, as given in the key.

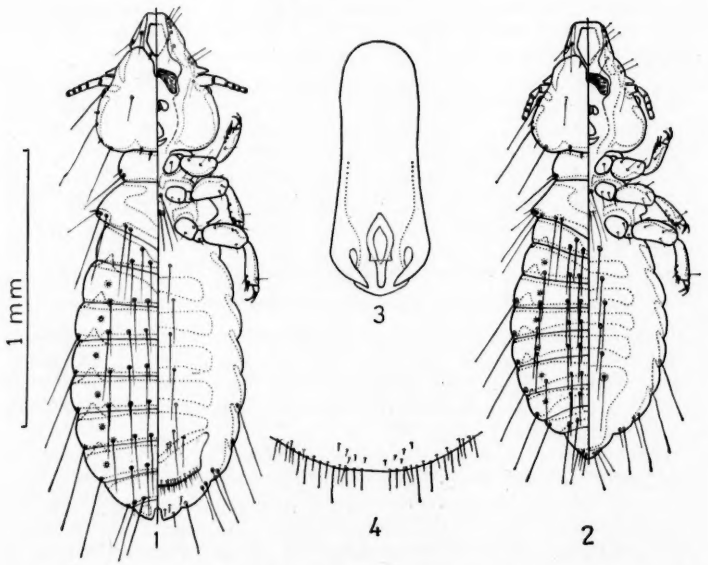

PLATE I. *Penenirmus auritus evagans* (Kellogg, 1896). Fig. 1. Dorsal-ventral view of female. Fig. 2. Dorsal-ventral view of male. Fig. 3. Male genitalia. Fig. 4. Posterior margin of female vulva. Figures 1 and 2 drawn to the same scale.

Measurements

	Male	Female
Length of head	0.52 mm	0.59 mm
Breadth of head	0.45	0.52
Breadth of prothorax	0.29	0.33
Breadth of pterothorax	0.45	0.52
Breadth of abdomen	0.60	0.61
Total length	1.71	2.04

Specimens from the Red-headed Woodpecker, *Melanerpes erythrocephalus erythrocephalus* (Linnaeus), collected in Kansas, South Carolina, North Carolina, Virginia, and Indiana are considered to be this species.

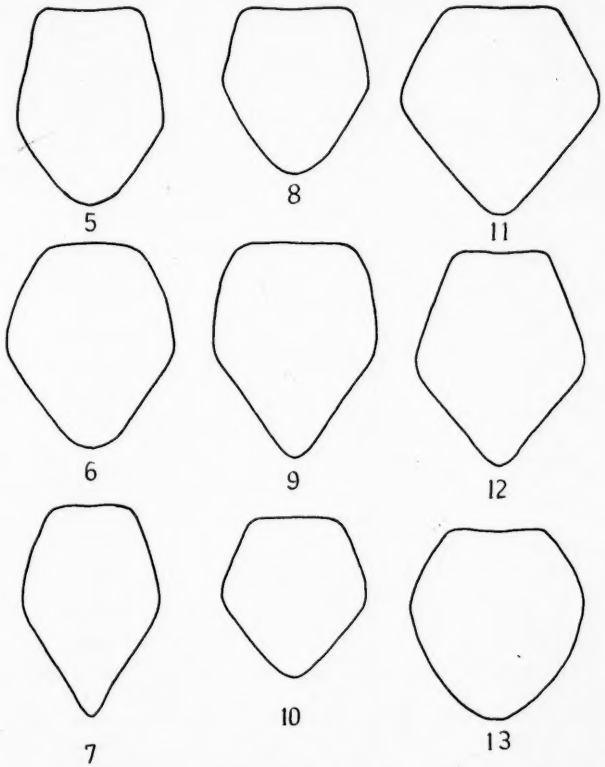

PLATE II. Dorsal anterior plate of forehead, *Penenirmus* sp. Fig. 5. *P. auritus evagans* (Kellogg, 1896). Fig. 6. *P. jungens* (Kellogg, 1896). Fig. 7. *P. californiensis californiensis* (Kellogg, 1896). Fig. 8. *P. californiensis varius* Emerson, 1953. Fig. 9. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 10. *P. californiensis arcticus* Carriker, 1958. Fig. 11. *P. serrilimbus pileatus* n. subsp. Fig. 12. *P. serrilimbus asyndesmus* n. subsp. Fig. 13. *P. villosus* n. sp. All figures drawn to the same scale.

Penenirmus californiensis varius Emerson, 1953

Penenirmus varius Emerson. 1953. Jour. Kansas Ent. Soc., 26:134, figs. 6 and 8.

Described from specimens collected off the Yellow-bellied Sapsucker, *Sphyrapicus varius varius* (Linnaeus), from Arizona. Illustrations are for paratypes. Other specimens examined were off: *Sphyrapicus varius varius* (Linnaeus), from Indiana; *S. v. appalachiensis* Ganier, from Virginia; *S. v. nuchalis* Baird, from Arizona; *S. v. ruber* (Gmelin), from Alaska; and *S. v. daggetti* Grinnell, from California.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 8,

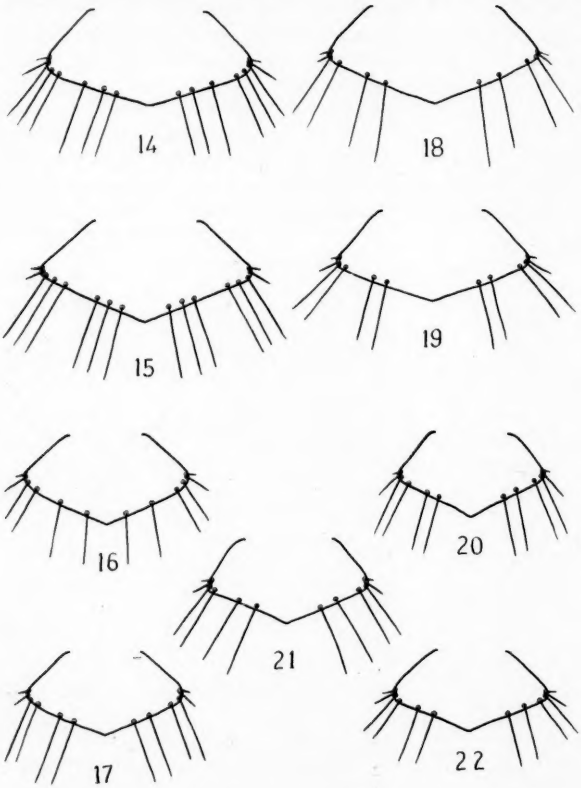

PLATE III. Dorsal view of pterothorax, *Penenirmus* sp. Fig. 14. *P. jungens* (Kellogg, 1896). Fig. 15. *P. villosus* n. sp. Fig. 16. *P. californiensis californiensis* (Kellogg, 1896). Fig. 17. *P. californiensis arcticus* Carriker, 1958. Fig. 18. *P. serrilimbus pileatus* n. subsp. Fig. 19. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 20. *P. auritus evagans* (Kellogg, 1896). Fig. 21. *P. serrilimbus asyndesmus* n. subsp. Fig. 22. *P. californiensis varius* Emerson, 1953. All figures drawn to the same scale.

chaetotaxy of pterothorax as shown in Figure 22, and posterior margin of female vulva as shown in Figure 26, all of which are different from the nominate form. Also, this subspecies is slightly smaller than the nominate form.

Penenirmus californiensis arcticus Carriker, 1958

Penenirmus arcticus Carriker. 1958. Proc. Ent. Soc. Wash., 60:168, figs. 1-2.

The original description was based on specimens collected off the Black-backed Three-toed Woodpecker, *Picoides arcticus* (Swainson), at Pike Lake, Michigan. Illustrations are from paratypes.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 10, chaetotaxy of pterothorax as shown in Figure 17, and posterior margin of female vulva as shown in Figure 27. The size and chaetotaxy of the pterothorax do not appear to be distinctive, but the other two characters given are distinctive.

Specimens from the Northern Three-toed Woodpecker, *Picoides tridactylus bacatus* Bangs, collected in Labrador are considered to be this subspecies.

Penenirmus serrilimbus serrilimbus (Burmeister, 1838)

Docophorus serrilimbus Burmeister. 1838. Handb. Ent., 2:427.

The original description was based on specimens collected off *Jynx torquilla* Linnaeus. Specimens off the type host collected in England were examined.

Diagnosis. Dorsal anterior plate of the forehead is the same shape as that shown in Figure 9. Chaetotaxy of pterothorax is the same as that shown in Figure 19. Posterior margin of female vulva as shown in Figure 28.

Measurements

	Male	Female
Length of head	0.51 mm	0.62 mm
Breadth of head	0.44	0.48
Breadth of prothorax	0.23	0.23
Breadth of pterothorax	0.40	0.48
Breath of abdomen	0.55	0.74
Total length	1.76	2.30

Penenirmus serrilimbus aurifrons Carriker, 1956

Penenirmus auritus aurifrons Carriker. 1956. Florida Ent., 39:37, figs. 34-35.

Described from specimens off the Golden-fronted Woodpecker, *Centurus aurifrons grateloupensis* (Lesson), collected in Mexico. Illustrations are for specimens off *Centurus aurifrons aurifrons* (Wagler), collected in Texas.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 9, chaetotaxy of pterothorax as shown in Figure 19, and posterior margin of female vulva as shown in Figure 29. Larger than the nominate form, and with a different chaetotaxy of the posterior margin of the female vulva.

Specimens from the Red-bellied Woodpecker, *Centurus carolinus carolinus* (Linnaeus), collected in South Carolina, Florida, and Georgia are considered to be this subspecies.

Penenirmus serrilimbus pileatus n. subsp.

Type host: Pileated Woodpecker, *Dryocopus pileatus abieticola* (Bangs).

Type material: From *Dryocopus pileatus abieticola* (Bangs)—Holotype male, allotype female and seventeen paratypes collected at Tillamook, Oregon, on November 14, 1929, and January 22, 1931, by Alexander Walker; one paratype collected at Woodinville, Washington, on April 7, 1935, by A. Hangen; and one paratype collected at Mercer Lake, Oregon, on January 28, 1933, by H. H. Stage. From *Dryocopus pileatus pileatus* (Linnaeus)—one paratype collected at Dewitt, Arkansas, on December 22, 1917, by A. Wetmore.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 11. Chaetotaxy of posterior margin of female vulva as shown in Figure 30. Pterothorax as shown in Figure 18. Total length of male 1.85 mm; of female, 2.18 mm. Distinguished from the other subspecies and the nominate form by the distinctive dorsal anterior plate of forehead, and chaetotaxy of the posterior margin of the female vulva.

Penenirmus serrilimbus asyndesmus n. subsp.

Type host: Lewis' Woodpecker, *Asyndesmus lewis* (Gray).

Type material: Holotype male, allotype female and nine paratypes collected at Seapoose, Oregon, on May 19, 1933, by C. M. Gjullin; one paratype collected at Logan, Utah, on July 19, 1946, by P. E. Telford; and ten paratypes collected at Portland, Oregon, on May 6, 1932, by M. F. Conova; all specimens were off the type host.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 12. Pterothorax as shown in Figure 21. Chaetotaxy of posterior margin of female vulva as shown in Figure 31. Total length of male, 1.55 mm; of female, 1.98 mm. Distinguished from other subspecies and the nominate form by the distinctive dorsal anterior plate of the forehead, chaetotaxy of the pterothorax, and chaetotaxy of the posterior margin of the female vulva.

Penenirmus serrilimbus fiebrigi Eichler, 1953

Penenirmus fiebrigi Eichler. 1953. Zool. Anz., 150: 240, figs. 2, 7, and 11.

The type host is *Colaptes campestris campestroides* (Malherbe), found in southern South America. Paratypes, in poor condition, were examined. The dorsal anterior plate of the forehead and the chaetotaxy of the posterior margin of the female vulva differ from the other subspecies.

Penenirmus jungens (Kellogg, 1896)

Docophorus jungens Kellogg. 1896. Proc. Calif. Acad. Sci., 6:481, pl. 66, fig. 4.

The original description was based on specimens off the Yellow-shafted Flicker, *Colaptes auratus lutens* Bangs, collected at Lawrence, Kansas. Illustrations and measurements are for specimens from the type host collected in Oklahoma. Other specimens examined were off: *Colaptes auratus lutens* Bangs, from Indiana, New York, and Iowa; *C. a. auratus* (Linnaeus),

from Texas and Virginia; and *C. a. borealis* Ridgway, from Mississippi.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 6, chaetotaxy of pterothorax as shown in Figure 14, and posterior margin of female vulva as shown in Figure 24 are distinctive. Other characters, except for measurements, as given in the key.

Measurements

	Male	Female
Length of head	0.56 mm	0.63 mm
Breadth of head	0.52	0.60
Breadth of prothorax	0.31	0.35
Breadth of pterothorax	0.51	0.61
Breadth of abdomen	0.69	0.69
Total length	1.82	2.21

Specimens from the Red-shafted Flicker, *Colaptes cafer cafer* (Gmelin), collected in Oregon; and from *Colaptes cafer collaris* Vigors, collected in Texas and Ohio are considered to be this subspecies.

Penenirmus villosus n. sp.

Type host: Hairy Woodpecker, *Dendrocopos villosus villosus* (Linnaeus).

Type material: Holotype male, allotype female and two paratypes off *Dendrocopos villosus villosus* (Linnaeus), collected at Orient, New York, on May 2, 1952, by Roy Latham. Seven paratypes off *Dendrocopos villosus audubonii* (Swainson), collected at Hamburg, Mississippi, on December 24, 1914, by W. E. Dove. Six paratypes off *Dendrocopos villosus harrisi* (Audubon), collected at Tillamook, Oregon, on November 19, 1929, by Alexander Walker. Two paratypes off *Dendrocopos villosus monticola* (Anthony), collected at Florence, Montana, on April 1, 1910, by W. V. King. In the British Museum (NH), forty-eight paratypes off *Dendrocopos villosus hyloscopus* (Cabanis and Heine), collected in California in 1939.

Diagnosis. Dorsal anterior plate of forehead as shown in Figure 13, pterothorax as shown in Figure 15, and chaetotaxy of posterior margin of female vulva as shown in Figure 32 are distinctive. Other characters, except for measurements, as given in the key.

Measurements

	Male	Female
Length of head	0.52 mm	0.58 mm
Breadth of head	0.48	0.56
Breadth of prothorax	0.30	0.33
Breadth of pterothorax	0.51	0.58
Breadth of abdomen	0.65	0.79
Total length	1.75	2.05

Penenirmus heteroscelis (Nitzsch, 1866)

Pediculus pici Schrank. 1803. Fauna Boica. Landshut.: 188. (*nec* J. C. Fabricius, 1798).
Nirmus heteroscelis Nitzsch. 1866. *In Giebel*, Z. ges. NatWiss., 27:117.
Philopterus kumagera Uchida. 1949. Jap. Med. Jour., 1:544, fig. 12.

The type host of this species is *Dryocopus martius martius* (Linnaeus),

found in the northern regions of the Old World. Specimens were not available for study, therefore this classification is tentative based on descriptions and illustrations.

Penenirmus pici (J. C. Fabricius, 1798)

Pediculus pici J. C. Fabricius. 1798. Ent. Syst. Suppl.: 571.
Docophorus scalaris Burmeister. 1838. Handb. Ent., 2:427.

Clay and Hopkins (1960) designated neotypes from specimens collected off the type host, *Picus viridis viridis* Linnaeus, from England. Neoparatypes were examined.

Penenirmus campephili Eichler, 1953

Penenirmus campephili Eichler. 1953. Zool. Anz., 150:239, figs. 16-17.

The type host is *Campephilus magellanicus* (King), found in Chile and Argentina. The paratypes examined were in such poor condition that the information utilized in the key had to be obtained from Eichler's description and illustrations.

Penenirmus maculipes (Piaget, 1880)

Docophorus maculipes Piaget. 1880. Les Pediculines: 661, pl. 54, fig. 3.

The type host for this species was given by Piaget as *Picus* from Bangka. The information utilized in the key was provided by Dr. Clay, who

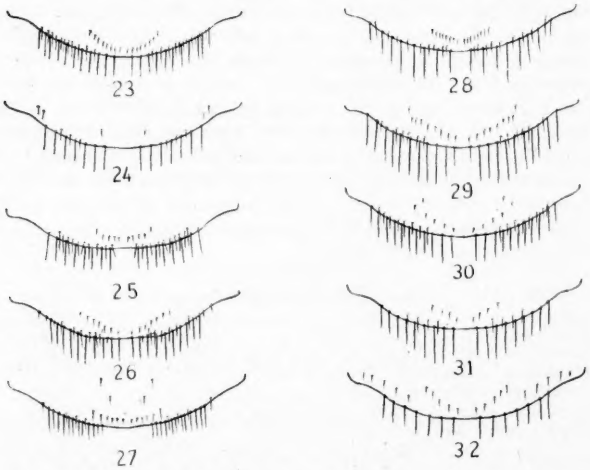

PLATE IV. Posterior margin of female vulva, *Penenirmus* sp. Fig. 23. *P. auritus auritus* (Scopoli, 1763). Fig. 24. *P. jungens* (Kellogg, 1896). Fig. 25. *P. californiensis californiensis* (Kellogg, 1896). Fig. 26. *P. californiensis varius* Emerson, 1953. Fig. 27. *P. californiensis arcticus* Carriker, 1958. Fig. 28. *P. serrilimbus serrilimbus* (Burmeister, 1838). Fig. 29. *P. serrilimbus aurifrons* Carriker, 1956. Fig. 30. *P. serrilimbus pileatus* n. subsp. Fig. 31. *P. serrilimbus asyndesmus* n. subsp. Fig. 32. *P. villosus* n. sp.

examined the type in the British Museum (Natural History). Dr. H. G. Deignan, U.S. National Museum, informs us that "*Picus* from Bangka" could be one of the following hosts: *Picus puniceus observandus* (Hartert), *Picus mineaceus malaccensis* Latham, *Picus mentalis humii* (Hargitt), *Dinopium rafflesii rafflesii* (Vigors and Horsfield), *Micropternus brachyurus badius* (Raffles), *Hemicircus concretus coccometopus* (Reichenbach), and *Dryocopus javensis javensis* (Horsfield). Specimens from *Micropternus brachyurus* and *Dryocopus javensis* are not conspecific with the type, hence should no longer be considered for type host.

Penenirmus tuktola (Ansari, 1947)

Picophilopterus tuktola Ansari. 1947. Proc. Nat. Inst. Sci. India, 13:265, fig. 4.

The type host is *Picus squamatus squamatus* Vigors, found in southern Asia. Dr. Theresa Clay examined a paratype, in poor condition, and provided the information utilized in the key.

Penenirmus macrotrichus (Kolenati, 1858)

Docophorus macrotrichus Kolenati. 1858. S. B. Akad. Wiss. Wien, 29:248, pl. 1, fig. 5.

Specimens from the type host, *Picus flavinucha* Gould, collected in Thailand were examined.

LITERATURE CITED

Ansari, M. A. R. 1947. Mallophaga (Ischnocera) infesting birds of the Punjab (India). Proc. Nat. Inst. Sci. India, 13:253-303.

Burmeister, M. C. C. 1838. Handbuch der Entomologie, II. Berlin.

Carriker, M. A. 1956. Report on a collection of Mallophaga, largely Mexican (Part II). Florida Ent., 39:20-43, 69-84, and 119-132.

———. 1958. On a small collection of Mallophaga from the United States, with descriptions of three new species. Proc. Ent. Soc. Wash., 60:167-174.

Clay, T. and G. H. E. Hopkins. 1951. The early literature on Mallophaga (Part II). Bull. Brit. Mus. (NH), Ent., 2:3-37.

———. 1960. The early literature on Mallophaga (Part IV). Bull. Brit. Mus. (NH), Ent., 9:1-61.

Clay, T. and R. Meinertzhagen. 1938. Two new genera of Mallophaga. Entomologist, 71:73-76.

Eichler, W. 1953. Mallophagen-Synopsis. XXIV. Genus *Penenirmus* (incl. *Picophilopterus*). Zool. Anz., 150:235-245.

Emerson, K. C. 1953. New North American Mallophaga. Jour. Kansas Ent. Soc., 26: 132-136.

———. 1958. Catalogue of the types in the Snow Entomological Museum. Part II (Mallophaga). Univ. Kansas Sci. Bull., 49:507-518.

Fabricius, J. C. 1798. Supplementum Entomologiae Systematicae. Hafniae.

Kellogg, V. L. 1896. New Mallophaga II. Proc. Calif. Acad. Sci., 6:431-548.

Kolenati, F. A. 1858. Zwei neue österreichische Philopteriden. S. B. Akad. Wiss. Wien, 29:247-249.

Nitzsch, C. L. 1866. *In Giebel,* Die Federinge der Sing-, Schrei-, Kletter- und Taubenvogel. Z. ges. NatWiss., 27:115-122.

Piaget, E. 1880. Les Pediculines. Leiden.

Scopoli, J. A. 1763. Entomologia Carniolica. Vindobonae.

Uchida, S. 1949. Studies on the biting-lice (Mallophaga) of Japan and adjacent territories (Suborder Ischnocera Pt. II). Jap. Med. Jour., 1:535-556.

ANDROEURYOPS, A NEW GENUS OF TACHINIDAE (DIPTERA) FROM CENTRAL AMERICA

DAVID F. BENEWAY[1]

In connection with his studies of army ants in Panama, Mr. Carl W. Rettenmeyer collected a large series of tachinid flies that had been hovering over swarm raids of the ants. These were sent to Mr. Curtis W. Sabrosky of the U. S. National Museum for identification. Mr. Sabrosky's opinion was that the flies represented a new genus and he has kindly permitted the present author to describe it.

Androeuryops, new genus

From the Greek: *andros*, male; *eurys*, wide; and *ops*, a face. *Androeuryops* is here used in the masculine gender. A discussion of the gender to be attributed to "ops" names is found in Hemming (1958).

Head (Figs. 1 and 2) with eyes bare. Frons of nearly equal width from base of antennae to vertex in both male and female; width of frons at vertex greater in male than in female. Arista bare; second aristal segment about as broad as long. Ocellar bristles present, proclinate, and widely diverging. Frons with a double row of cruciate frontal bristles extending to bases of antennae but not below; no bristles outside frontal row in either sex. Inner vertical bristles well developed, outer vertical bristles absent. Vibrissae moderately strong, located well above oral margin. Proboscis of moderate length; palpi well developed, normal.

Thorax almost devoid of bristles on dorsum, chaetotaxy as follows: acrostichals 0:1; dorsocentrals 0:1; intraalars 1:1; supraalars 0:1; humerals 1; postalars 2; notopleurals 2; sternopleurals 2; lateral scutellars 2. Propleuron and sternopleuron bare. Infrasquamal setulae present but light colored and scarcely discernible. Continuous sclerotized area behind hind coxae absent. Wing with apical cell closed, petiolate. Third vein ending slightly behind wing tip. Lower calypter with outer margin straight to slightly concave, with narrowly rounded posterolateral angle.

Abdomen strongly dorso-ventrally flattened; brown in ground color; nearly devoid of macrochaetae but covered with hairs. Ovipositor sheath narrow and tapering, pointed at apex.

The genus belongs in Townsend's tribe Phasiini (1936, p. 53). In available keys it runs to *Hyalomya (sic)* in Curran (1934) and to *Heyneophasia* in Townsend (1936, p. 57) and in Brooks (1945). *Heyneophasia* Townsend is the closest genus and it shares in common with the new genus the character of the frons being wider at the vertex in the male than in the female. *Heyneophasia* differs from the new genus, however, in having the lower calypter evenly rounded, the ovipositor sheath broadly knobbed at apex, and a continuous sclerotized area behind the hind coxae as well as other minor differences.

Type species: *Hyalomyia ecitonis* Townsend.

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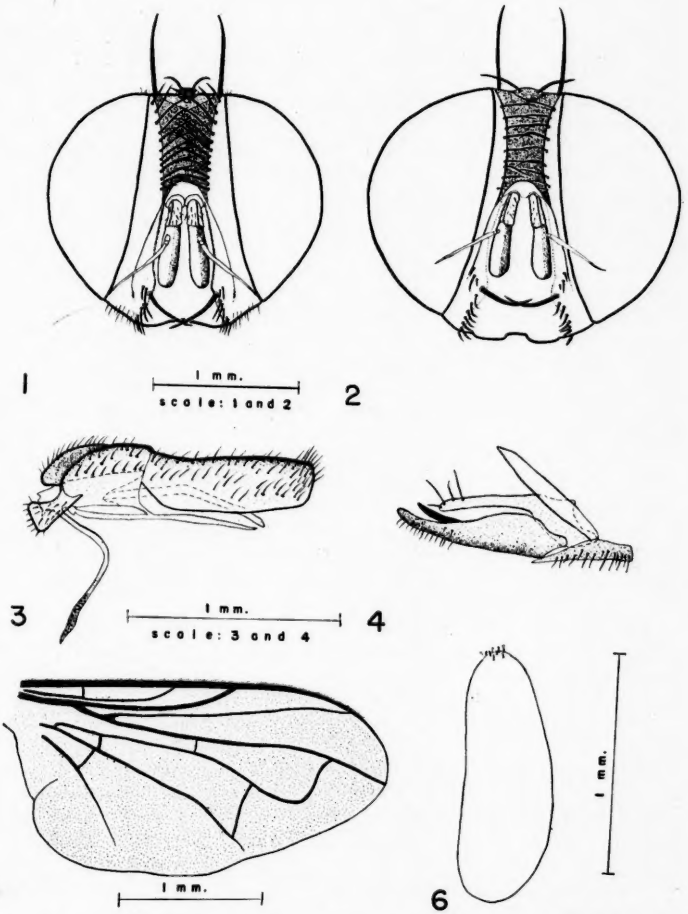

Androeuryops ecitonis (Tns.). 1. frontal view of head of male; 2. frontal view of head of female; 3. right lateral view of male genitalia; 4. right lateral view of female genitalia; 5. right wing of female; 6. lateral view of egg.

Androeuryops ecitonis (Townsend), new combination
Hyalomyia ecitonis Townsend. 1897. Ann. Mag. Nat. Hist., ser. 6, 20:31-32.

MALE. *Head:* Occipital orbits and parafrontals silvery gray to golden pollinose. Frontal vitta dark brown; about one-half width of frons at narrowest part near bases of antennae and widening slightly posteriorly until at vertex it nearly occupies entire width of frons. Parafacials gray pollinose. Clypeus not depressed, flush with parafacials. Antennae short, reaching about halfway to oral margin. Third antennal segment about twice length of second.

Thorax black in ground color, largely covered with yellow pollen. Dorsum with four black vittae, which appear differently in different reflections. Scutellum black, without yellow pollen. Legs brown, with very little gray pollen. Pulvilli of front tarsi about as long as last two tarsal segments. Tibiae with preapical bristles present. Wings (Fig. 5) lightly infuscated. Apical cell closed, long petiolate. Hind cross-vein varying from slightly sinuate to nearly straight. Veins bare, devoid of bristles. Costal spine absent. Epaulets and basicostal scales black.

Abdomen strongly dorso-ventrally flattened; brown in ground color and almost entirely bare and shining. A purplish cast is evident which appears differently in different reflections. Abdomen almost entirely devoid of macrochaetae but covered with hairs. A trace of golden pollen visible on posterior margin of segment four.

Genitalia (Fig. 3) highly modified from the usual muscoid type.

FEMALE. Ratio of frontal width at vertex to head width less than in male (usually the reverse of this situation occurs in muscoid Diptera). Pulvilli of front tarsi much shorter, slightly shorter than last tarsal segment. Abdomen covered with gray pollen except for first segment which is black and shining. Genitalia (Fig. 4) with ovipositor sheath narrow, tapering to a blunt point at apex. Otherwise similar to the male.

EGG (Fig. 6) of the macrotype class, about 1.1 mm. long by 0.4 mm. wide; concave on lower surface, convex on upper surface; with 11 blunt protuberances (counted from two specimens) at posterior end (considered here as the end of the egg which is laid first).

Twenty-five males and 25 females were measured for head width (H.W.) and frontal width at vertex (F.W.V.). The head width is taken from the frontal view of the head and is measured as the distance from the outside eye margin of one side to the outside eye margin of the other side. The frontal width at vertex is taken from the dorsal view of the head and is measured as the greatest width of the frons at the vertex. The ratio is obtained by dividing the head width into the frontal width at the vertex and multiplying by 100. Measurements are given in millimeters. Results are as follows:

	Mean		Range	
	♂	♀	♂	♀
H.W.	2.013±.179	1.891±.175	1.627–2.353	1.667–2.244
F.W.V.	0.545±0.46	0.472±.035	0.462–0.660	0.429–0.528
Ratio	27.0±.041	25.0±.039	24.8–29.7	22.8–27.3

Type. Townsend (1897b) described the species from: "Nine males and

seven females, Paso de Telaya, March 29." No holotype was designated. Fourteen of the original sixteen specimens are located at the British Museum (Natural History) and Dr. Harold Oldroyd has kindly loaned me one male and one female. A male syntype labeled San Rafael, Vera Cruz, March 29 (no year), Coll. Townsend, is here designated as lectotype.

Lectoparatypes: Thirteen males and females, San Rafael, Vera Cruz, March 29 (no year), Coll. Townsend.

It will be noted that there is a discrepancy between the type locality stated in Townsend's original description and the locality label on the specimens in the type series. Townsend (1897a, p. 16) says: "Paso de Telaya is but two miles from San Rafael, and really forms a part of that settlement." In the same paper he also clearly states that the specimens were taken "in a cafetal at Paso de Telaya, during the last hour or two of daylight on March 29." (p. 23). Thus the discrepancy appears to be in the labeling of the specimens rather than in the original description. San Rafael is at 20°12′ N., 96°52′ W.

Other material examined consists of about 340 males and 180 females from Barro Colorado Island, Canal Zone, Panama, February 10 - August 18, 1955-56; C. W. and M. E. Rettenmeyer. Of these, about 90 per cent were taken over swarm raids of *Eciton burchelli* and 10 per cent over swarm raids of *Labidus praedator* (Formicidae: Dorylinae). Specimens will be distributed to the British Museum (Natural History), the U. S. National Museum, the University of Kansas, and Dr. H. J. Reinhard.

I wish to acknowledge the aid of the following persons in the preparation of this paper. Mr. Curtis W. Sabrosky examined the material and compared it with several species of *Heyneophasia* which were not available to me. He also contributed valuable notes on the systematic position of the new genus. Dr. Harold Oldroyd of the British Museum (Natural History) loaned me two syntypes of *Hyalomyia ecitonis* Tns. Dr. George W. Byers read the manuscript and contributed criticisms and suggestions.

LITERATURE CITED

Brooks, A. R. 1945. A Revision of the North American species of the *Phasia* complex (Diptera, Tachinidae). Sci. Agric., Ottawa, 25:647-679, 28 figs.

Curran, C. H. 1934. The Families and Genera of North American Diptera. The Ballou Press, N.Y., 512 pp., illus.

Hemming, Francis. 1958. Opinions and Declarations Rendered by the International Commission on Zoological Nomenclature, Volume 18, Declaration 36. Determination under Decision 85 of the Fourteenth International Congress of Zoology, Copenhagen, 1953, of the gender to be attributed to generic names having the terminations "-ops" and "-opsis" respectively. pp. i-xii.

Rettenmeyer, C. W. 1961. Observations on the Biology and Taxonomy of Flies Found Over Swarm Raids of Army Ants. Univ. Kansas Sci. Bull. (in press).

Townsend, C. H. T. 1897a. Contributions from the New Mexico Biological Station. —No. 2. On a Collection of Diptera from the Lowlands of the Rio Nautla, in the State of Vera Cruz. I. Ann. Mag. Nat. Hist., (6) 19:16-34.

———. 1897b. Contributions from the New Mexico Biological Station. —No. II. (Continued). On a Collection of Diptera from the Lowlands of the Rio Nautla, in the State of Vera Cruz. Ann. Mag. Nat. Hist., (6) 20:19-33, 272-291.

———. 1936. Manual of Myiology in Twelve Parts. Part III. Oestroid Classification and Habits. Gymnosomatidae to Tachinidae. São Paulo, Brasil, 249 pp.

NOTICE OF MEETING

The sixteenth annual meeting of the North Central Branch, Entomological Society of America, will be held March 22, 23, and 24, 1961, at the Hotel President in Kansas City, Missouri.

ANNUAL MEETING, KANSAS ENTOMOLOGICAL SOCIETY

The annual meeting of the Kansas Entomological Society (Central States Entomological Society) will be held on Saturday, April 29, at Kansas State University, Manhattan, Kansas.

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